1987



SERVICE MANUAL

CHEVROLET

GM

ST-364-87

1987 CORVETTE SERVICE MANUAL

FOREWORD

This manual contains procedures for diagnosis, maintenance adjustments, minor service operations, replacement of components (Service) and for disassembly and assembly of major components (Unit Repair-Overhaul).

The manual is divided into two parts:

CHASSIS SERVICE
AND
BODY SERVICE

The Table of Contents on this page enables the user to quickly locate any desired section. At the beginning of each individual section containing more than one major subject is a Table of Contents, which gives the page number on which each major subject begins. When necessary, an index is placed at the beginning of each major subject within the section.

Summaries of Special Tools, when required, are found at the end of major sections. Specifications covering vehicle components are presented at the rear of each section.

Any reference to brand names in this manual is intended merely as an example of the types of lubricants, tools, materials, etc., recommended for use. In all cases, an equivalent may be used.

This manual should be kept in a handy place for ready reference. If properly used, it will enable the technician to better serve the owners of Chevrolet vehicles.

All information, illustrations and specifications contained in this literature are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

A separate Electrical Diagnosis Manual containing basic electrical system diagnostic and troubleshooting hints will be provided under separate cover.

CAUTION

This vehicle contains many parts dimensioned in the metric system. Most fasteners are metric and many are very close in dimension to familiar customary measurements in the inch system. However, it is important to note that, during any vehicle maintenance procedures, replacement fasteners must have the same measurements as those removed, whether metric or customary. Mismatched or incorrect fasteners can result in vehicle damage or malfunction, or possibly personal injury. Therefore, fasteners removed from the vehicle should be saved for re-use whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original.

CHEVROLET MOTOR DIVISION
General Motors Corporation
DETROIT, MICHIGAN

1986 General Motors Corporation Printed in Canada

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CAUTION

To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed:

Proper service and repair are important to the safety of the service technician and the safe, reliable operation of all motor vehicles. If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part. Do not use a replacement part of lesser quality.

The service procedures recommended and described in this service manual are effective methods of performing service and repair. Some of these procedures require the use of tools specially designed for the purpose.

Accordingly, anyone who intends to use a replacement part, service procedure or tool, which is not recommended by the vehicle manufacturer, must first determine that neither his safety nor the safe operation of the vehicle will be jeopardized by the replacement part, service procedure or tool selected.

It is important to note that this manual contains various 'Cautions' and 'Notices' that must be carefully observed in order to reduce the risk of personal injury during service or repair, or the possibility that improper service or repair may damage the vehicle or render it unsafe. It is also important to understand that these 'Cautions' and 'Notices' are not exhaustive, because it is impossible to warn of all the possible hazardous consequences that might result from failure to follow these instructions.

SECTION OA

GENERAL INFORMATION

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GENERAL INFORMATION

Information to identify the vehicle and vehicle components appears in this section. Detailed specifications on major units are given at the end of each respective section in this manual.

VEHICLE IDENTIFICATION NUMBER (VIN)

This is the legal identification of the vehicle. It appears on a plate which is attached to the left top of the instrument panel, and can be easily seen through the windshield from outside the car (Fig. OA-1). The VIN also appears on the Vehicle Certificates of Title and Registration. Refer to Figure OA-2 for VIN plate identification.

FLUID CAPACITIES

Refer to Figure OA-3 for fluid capacities.

UNIT IDENTIFICATION NUMBERS

For the convenience of service personnel when writing up certain business papers such as Warranty Claims or Product Information Reports, Figures OA-4 through 0A-5 indicate the location of unit identification numbers for the various components.

LUBRICATION POINTS

Refer to Figure OA-7 for typical lubrication points.

VEHICLE LIFTING PROCEDURES

NOTICE: When jacking or lifting vehicle from frame side rails, be certain lift pads do not contact catalytic converter as damage to converter could result.

Figures OA-8 and OA-9 indicate the **preferred** methods of lifting the vehicle using a hoist. If any other hoist methods are used, special care must be used not to damage the fuel tank, filler neck, exhaust system or underbody.

Rear Spindle Support Protector Sleeve

The Rear Spindle Support Rods, along with a protector, may be used to support the rear end of the Corvette when using a twin post hoist to raise the vehicle

A protector for the spindle support rods may be fabricated as shown in Figure 0A-6 to prevent surface nicks or gouges where the lifts contact the rods.

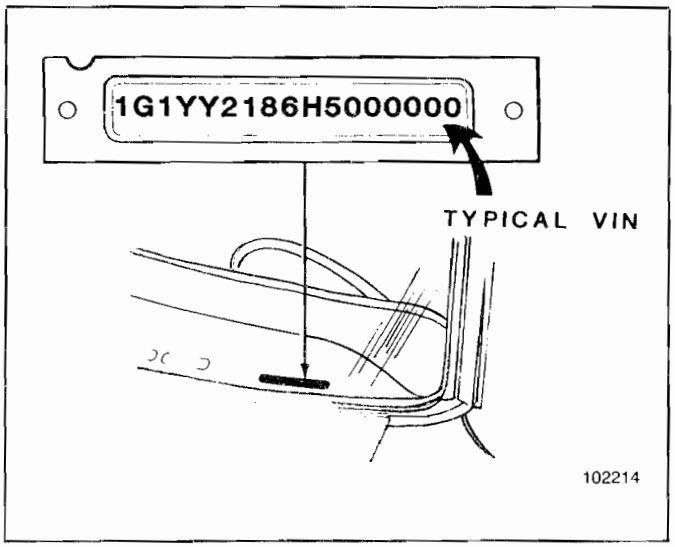


Figure OA-1 Vehicle Identification Number Location

PASSENGER CAR VEHICLE IDENTIFICATION NUMBER

1 G 1 YY 2 1 8 6 H 5 000000

NATION OF ORIGIN
1 U.S.A.
2 CANADA
3 MEXICO

MANUFACTURER
G GENERAL MOTORS

DIVISION
1 CHEVROLET
7 GM OF CANADA
C CHEVROLET (EL CAMINO)

CARLINE/SERIES

	CARLINE	SERIES
CELEBRITY	A	W
CAPRICE CLASSIC	B	N
CAPRICE	B	L
CAPRICE BROUGHAM	B	U
CAMARO SPORT COUPE	F	P
MONTE CARLO	G	Z
EL CAMINO	C*	W**
CAVALIER	J	C
CAVALIER RS	J	D
CAVALIER CS	J	E
CAVALIER Z24	J	F
CORSICA	L	T
BERETTA	L	V
CHEVETTE CS	T	B
CORVETTE	Y	Y

* INDICATES GVWR BRAKE SYSTEM
** INDICATES LINE AND CHASSIS TYPE

MODEL YEAR

H	1987
J	1988
K	1989
L	1990
M	1991

CHECK DIGIT

CODE ASSEMBLY PLANT

A	LAKEWOOD
D	DORAVILLE
E	LINDEN
G	FRAMINGHAM
H	FLINT (BUICK)
J	JANESVILLE
K	LEEDS
L	VAN NUYS
N	NORWOOD
R	ARLINGTON
S	RAMOS ARIZPE, MEX.
T	TARRYTOWN
W	WILLOW RUN
X	FAIRFAX
Y	WILMINGTON
1	OSHAWA
5	BOWLING GREEN
6	OKLAHOMA CITY
7	LORDSTOWN

PLANT SEQUENTIAL NUMBER

CODE	RPO	TYPE	CARLINE
C	L17	1.6L L4 2BBL	T
F	LB9	5.0L V8 TPI	F
G	LG9	5.0L V8 4BBL	G
H	LG4	5.0L V8 4BBL	B-G-F*
R	LR8	2.5L L4 EFI	A
S	LB8	2.8L V6 MFI	F
W	LB6	2.8L V6 MFI	A-J-L
Y	LV2	5.0L V8 4BBL	B
Z	LB4	4.3L V6 EFI	B-G*
1	LL8	2.0L L4 EFI	J-L
6	LM1	5.7L V8 4BBL	B
8	L98	5.7L V8 TPI	F-Y

*INDICATES EL CAMINO USAGE

CODE	DESCRIPTION	BODY STYLE
1	2-DR COUPE SEDAN	11,27,37,47,57,97
2	2-DR HATCHBACK	07,08,77,87
3	2-DR CONVERTIBLE	67
5	4-DR SEDAN	19,23,33,69
6	4-DR HATCHBACK	68
8	4-DR STATION WAGON	35

CODE	RESTRAINT SYSTEM
1	MANUAL BELTS
2	MANUAL BELTS W BUILT IN SAFETY
3	MANUAL BELTS W BUILT-IN SAFETY (DRIVER ONLY)
4	AUTOMATIC BELTS

Figure OA-2 Vehicle Identification Number Codes

APPROXIMATE CAPACITIES

Cooling System	13.29L	14.0 Qts.
Crankcase* 5.7L V8		
Oil Change Only	3.8L	4.0 Qts.
Oil and Filter Change	4.7L	5.0 Qts.
Automatic Transmission (700 R-4)		
Pan Removal	4.7L	10.0 Pts.
Overhaul	10.9L	23.0 Pts.
Fuel Tank	75.7L	20.0 Gal.

*After refill, check oil level as outlined in the "Service and Maintenance" section of the Owner's Manual

Figure OA-3 Fluid Capacities

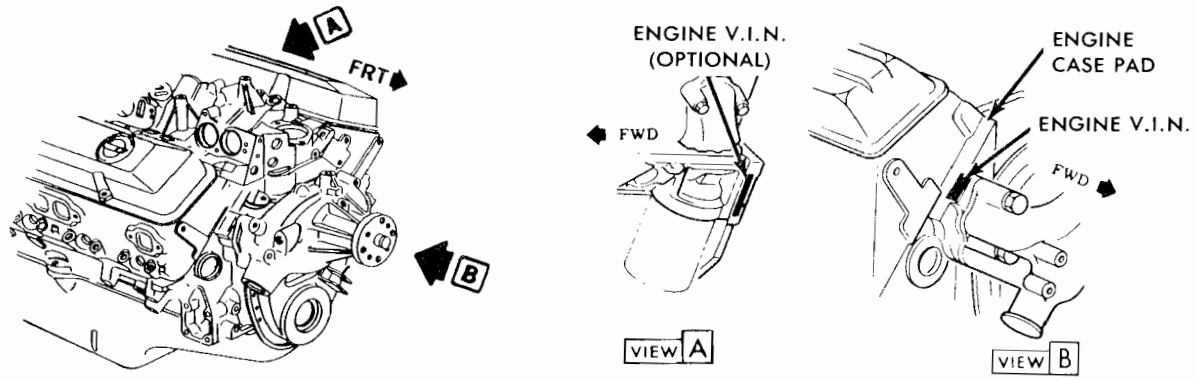


Figure OA-4 Engine V.I.N. Location

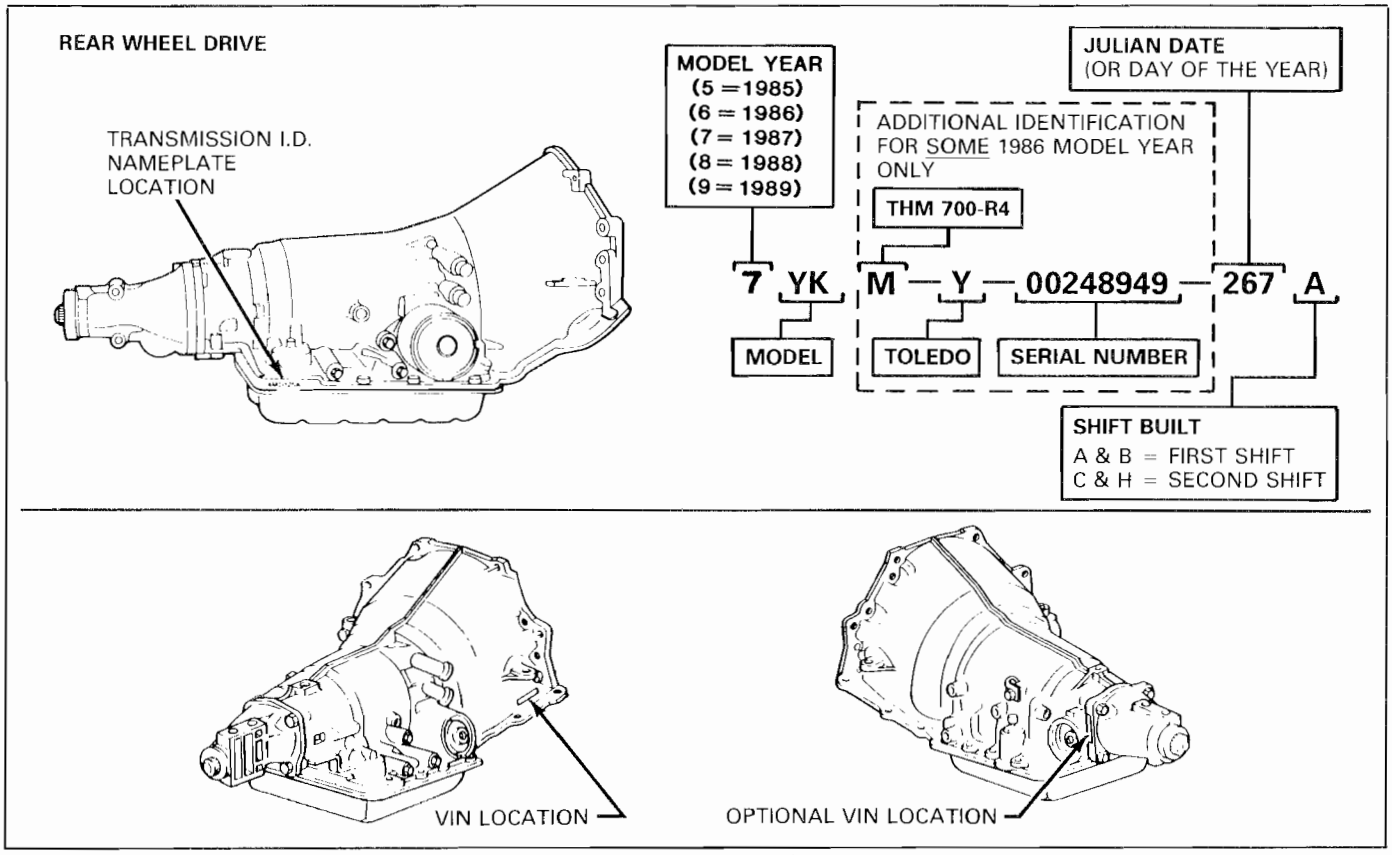


Figure 0A-5 Automatic Transmission Identification

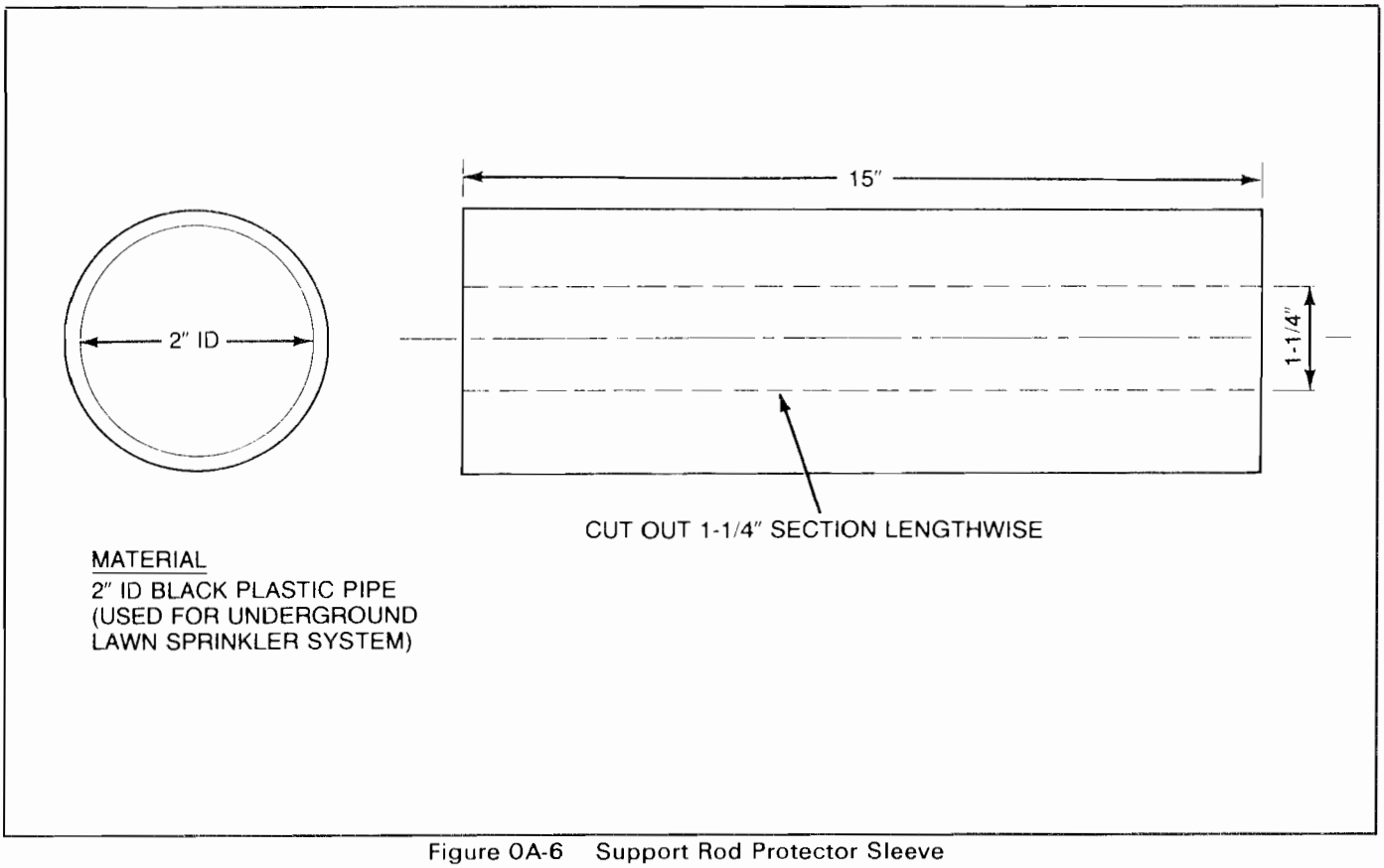


Figure 0A-6 Support Rod Protector Sleeve

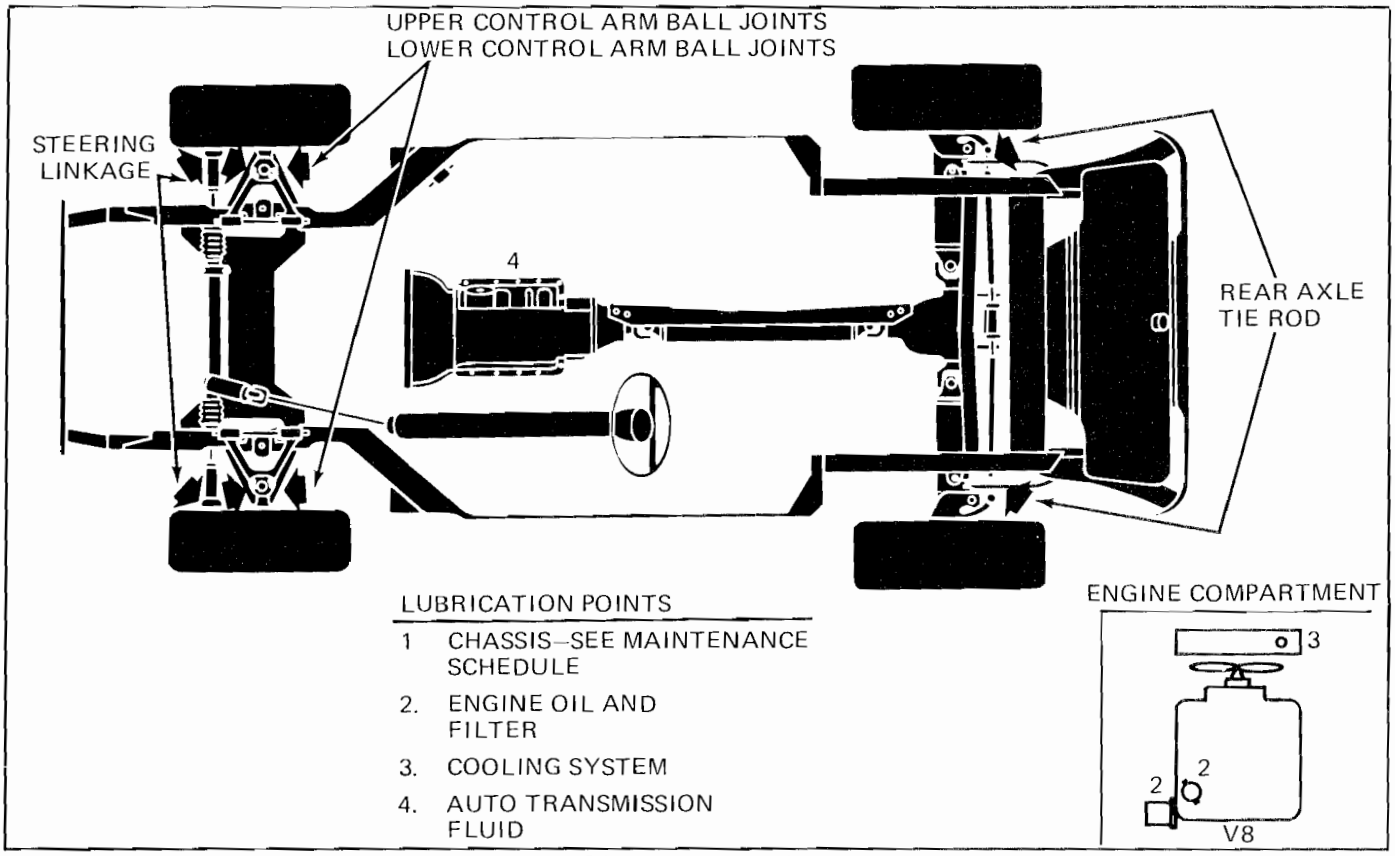
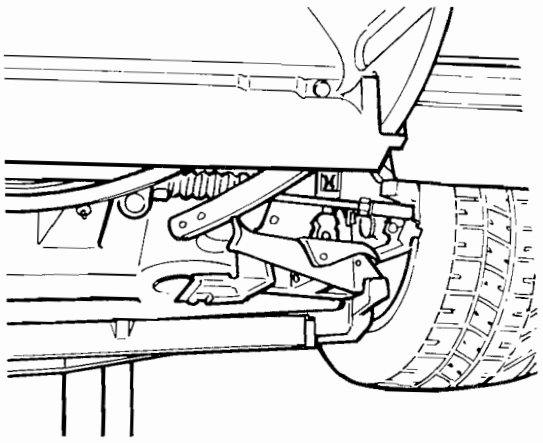
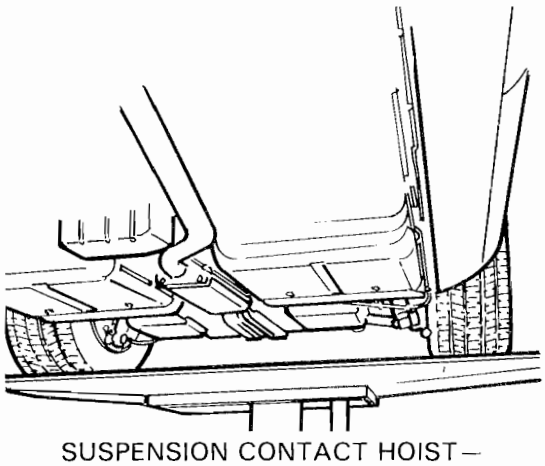


Figure OA-7 Lubrication Diagram

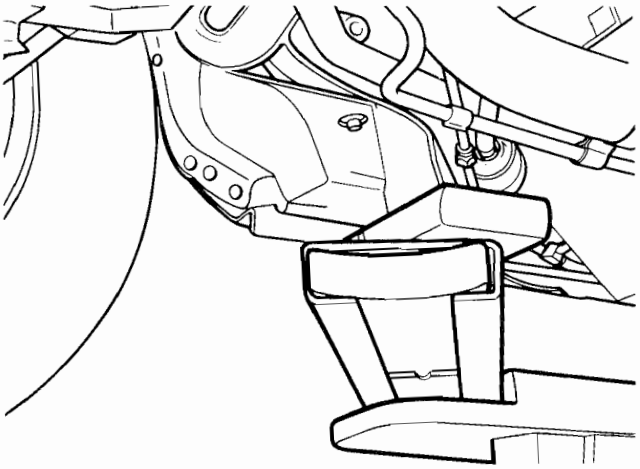


SUSPENSION CONTACT HOIST–
UNDER FRONT LOWER CONTROL ARM

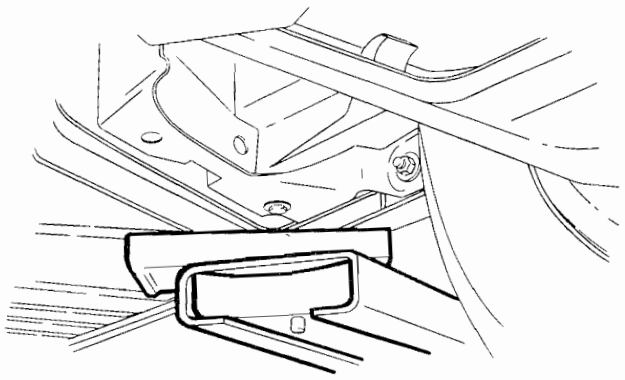


SUSPENSION CONTACT HOIST–
LIFT ON REAR WHEELS

Figure OA-8 Vehicle Lift Points - Suspension Contact Hoist



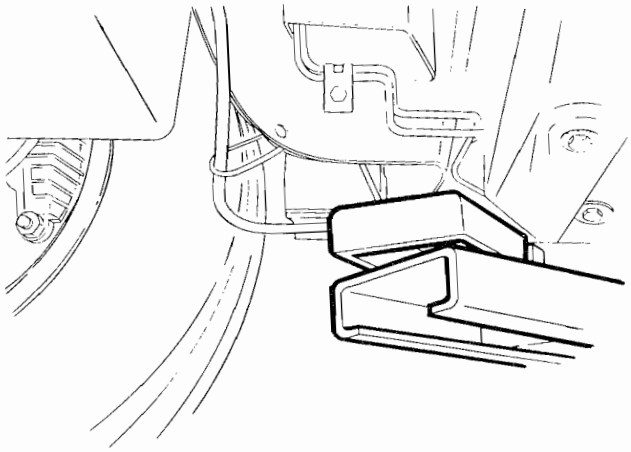
RIGHT SIDE
FRAME CONTACT HOIST
REARWARD OF FRONT WHEEL



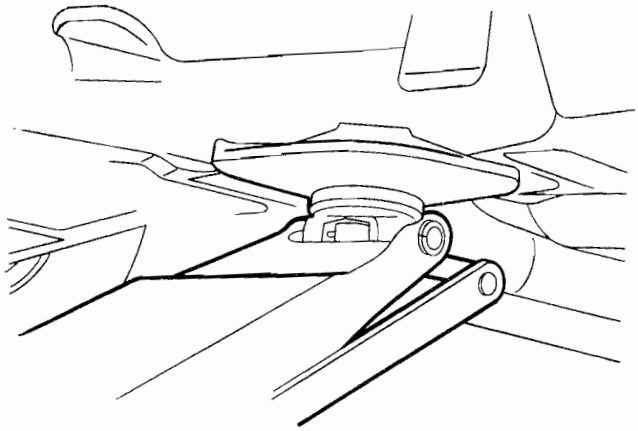
LEFT SIDE
FRAME CONTACT HOIST
REARWARD OF FRONT WHEEL



RIGHT SIDE
FRAME CONTACT HOIST
FORWARD OF REAR WHEEL



LEFT SIDE
FRAME CONTACT HOIST
FORWARD OF REAR WHEEL



FLOOR JACK-FRONT

Figure OA-9 Vehicle Lift Points (Cont.)

USE OF METRIC AND CUSTOMARY NUTS, BOLTS AND SCREWS

Some vehicles present special service requirements to the technician due to the use of both metric and customary (inch) type nuts, bolts and screws. Many are metric and some are very close in dimension to customary nuts, bolts and screws in the inch system. Mismatched or incorrect nuts, bolts and screws can result in damage, malfunction or possible personal injury. Nuts, bolts and screws removed from the vehicle should be saved for re-use whenever possible. If they are not re-usable, care should be taken to select a replacement that matches the original.

General Motors Engineering Standards have adopted a portion of the standard metric fastener sizes defined by SI (Systeme International). This was done to reduce the number of sizes used and yet retain the best strength characteristics in each thread size. For example, the customary 1/4-20 and 1/4-28 screws are replaced by the metric M6.3 x 1 screw which has nearly the same diameter and 25.4 threads per inch. The thread pitch is in between the customary coarse and fine thread pitches.

Metric and customary thread notation differ slightly. The difference is illustrated below.

CUSTOMARY	METRIC
1/4	M6.3
Thread Major Diameter in Inches	Thread Major Diameter in Millimeters
20	1
Number of Threads per Inch	Distance Between Threads in Millimeters

Care should be taken when servicing the vehicle to guard against cross threading or improper retention due to interchanged metric and inch nuts and bolts.

When obtaining metric or customary nuts, bolts, and screws locally for servicing the vehicle, care must be exercised in selecting parts that are equivalent to the original parts in dimensions, strength, and pitch of threads.

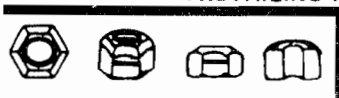
Figure OA-10 Metric Information, Chart A

REUSE OF PREVAILING TORQUE NUT(S) AND BOLT(S)

PREVAILING TORQUE NUTS ARE THOSE NUTS WHICH INCORPORATE A SYSTEM TO DEVELOP AN INTERFERENCE BETWEEN NUT AND BOLT THREADS INTERFERENCE IS MOST COMMONLY ACHIEVED BY DISTORTING TOP OF ALL-METAL NUT, BUT ALSO MAY BE ACHIEVED BY DISTORTING AT MIDDLE OF HEX FLAT, BY NYLON PATCH ON THREADS, BY NYLON WASHER INSERT AT TOP OF NUT AND BY NYLON INSERT THROUGH NUT.

PREVAILING TORQUE BOLTS ARE THOSE BOLTS WHICH INCORPORATE A SYSTEM TO DEVELOP AN INTERFERENCE BETWEEN BOLT AND NUT OR TAPPED HOLE THREADS. INTERFERENCE IS ACHIEVED BY DISTORTING SOME OF THE THREADS (SEVERAL METHODS EXIST), BY APPLYING A NYLON PATCH OR STRIP OR BY ADHESIVE COATING ON THREADS.

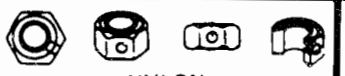
PREVAILING TORQUE NUTS



TOP LOCK MANY TYPES



CENTER LOCK



NYLON INSERT



NYLON PATCH

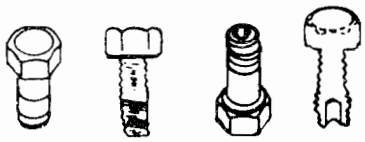


NYLON WASHER INSERT

PREVAILING TORQUE BOLTS



DRY ADHESIVE COATING



OUT OF ROUND THREAD AREA



NYLON STRIP OR PATCH



THREAD PROFILE DEFORMED

RECOMMENDATIONS FOR REUSE

A. CLEAN, UNRUSTED PREVAILING TORQUE BOLTS AND NUTS MAY BE REUSED AS FOLLOWS.

1. CLEAN DIRT AND OTHER FOREIGN MATERIAL OFF NUT AND BOLT.
2. INSPECT BOLT AND NUT TO ASSURE THERE ARE NO CRACKS, ELONGATION OR OTHER SIGNS OF ABUSE OR OVERTIGHTENING. LIGHTLY LUBRICATE THREADS. (IF ANY DOUBT, REPLACE WITH NEW PREVAILING TORQUE FASTENER OF EQUAL OR GREATER STRENGTH.)
3. ASSEMBLE PARTS AND START BOLT OR NUT.
4. OBSERVE THAT BEFORE FASTENER SEATS, IT DEVELOPS PREVAILING TORQUE PER CHART BELOW. (IF ANY DOUBT, INSTALL NEW PREVAILING TORQUE FASTENER OF EQUAL OR GREATER STRENGTH).
5. TIGHTEN TO TORQUE SPECIFIED IN SERVICE MANUAL.

B. BOLTS AND NUTS WHICH ARE RUSTY OR DAMAGED SHOULD BE REPLACED WITH NEW PARTS OF EQUAL OR GREATER STRENGTH.

METRIC SIZES

		6 & 6.3	8	10	12	14	16	20
NUTS AND ALL METAL BOLTS	N·m	0.4	0.8	1.4	2.2	3.0	4.2	7.0
	In. Lbs.	4.0	7.0	12	18	25	35	57
ADHESIVE OR NYLON COATED BOLTS	N·m	0.4	0.6	1.2	1.6	2.4	3.4	5.6
	In. Lbs	4.0	5.0	10	14	20	28	46

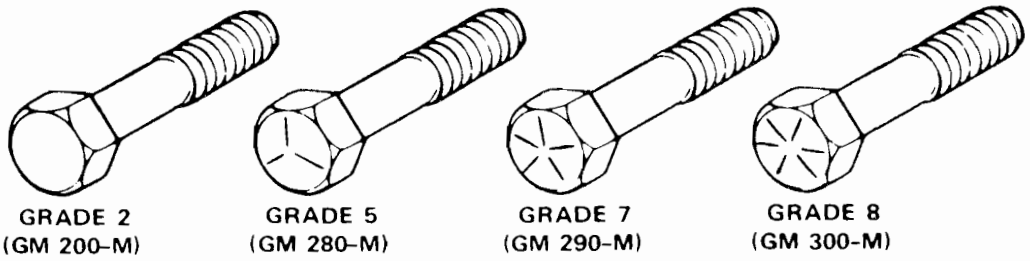
INCH SIZES

		250	312	375	437	500	562	625	750
NUTS AND ALL METAL BOLTS	N·m	0.4	0.6	1.4	1.8	2.4	3.2	4.2	6.2
	In. Lbs	4.0	5.0	12	15	20	27	35	51
ADHESIVE OR NYLON COATED BOLTS	N·m	0.4	0.6	1.0	1.4	1.8	2.6	3.4	5.2
	In. Lbs	4.0	5.0	9.0	12	15	22	28	43

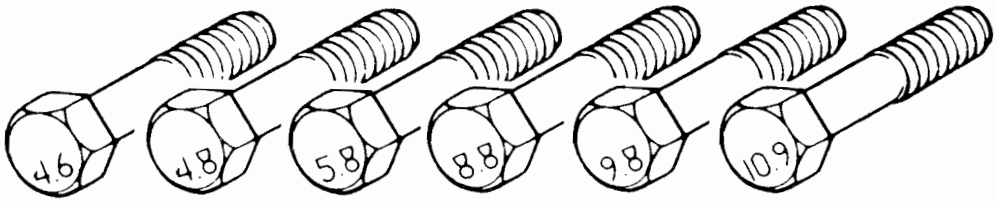
Figure OA-11 Metric Information, Chart B

METRIC BOLT AND NUT IDENTIFICATION

Common metric fastener strength property classes are 9.8 and 10.9 with the class identification embossed on the head of each bolt. Customary (inch) strength classes range from grade 2 to 8 with line identification embossed on each bolt head. Markings correspond to two lines less than the actual grade (i.e. grade 7 bolt will exhibit 5 embossed lines on the bolt head). Some metric nuts will be marked with single digit strength identification numbers on the nut face. The following figure illustrates the different strength markings.



Customary (inch) bolts - Identification marks correspond to bolt strength - Increasing numbers represent increasing strength.



Metric Bolts - Identification class numbers correspond to bolt strength - Increasing numbers represent increasing strength.

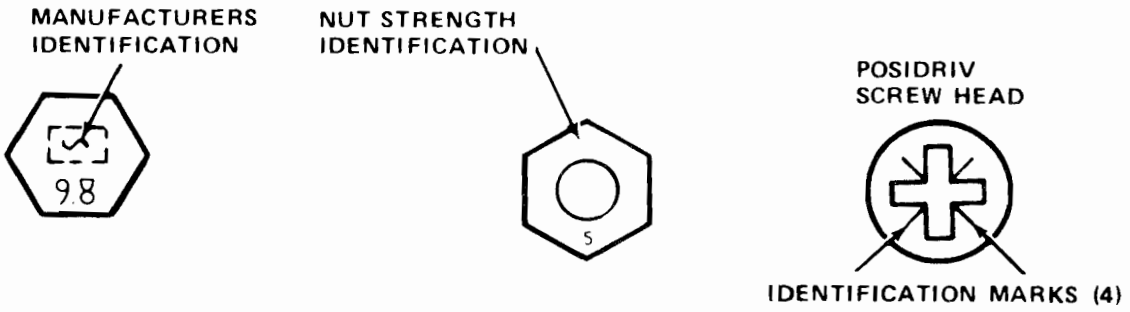
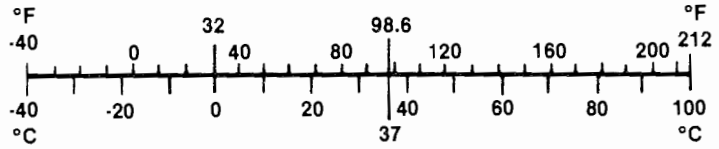


Figure OA-12 Metric Information, Chart C

SI METRIC-CUSTOMARY CONVERSION TABLE

Multiply	by	to get equivalent number of:
LENGTH		
Inch	25.4	millimeters (mm)
Foot	0.304	meters (m)
Yard	0.914	meters
Mile	1.609	kilometers (km)
AREA		
Inch^2	645.2	millimeters^2 (mm^2)
	6.45	centimeters^2 (cm^2)
Foot^2	0.092	meters^2 (m^2)
Yard^2	0.836	meters^2
VOLUME		
Inch^3	16 387.	mm^3
	16.387	cm^3
	0.016	liters (l)
Quart	0.946	liters
Gallon	3.785	liters
Yard^3	0.764	meters^3 (m^3)
MASS		
Pound	0.453	kilograms (kg)
Ton	907.18	kilograms (kg)
Ton	0.907	tonne (t)
FORCE		
Kilogram	9.807	newtons (N)
Ounce	0.278	newtons
Pound	4.448	newtons
TEMPERATURE		
Degree Fahrenheit	(°F-32) ÷ 1.8	degree Celsius (C)



Multiply	by	to get equivalent number of:
ACCELERATION		
Foot/sec^2	0.304	meter/sec^2 (m/s^2)
Inch/sec^2	0.025	meter/sec^2
TORQUE		
Pound-inch	0.112	newton-meters (N-m)
Pound-foot	1.355	newton-meters
POWER		
Horsepower	0.746	kilowatts (kW)
PRESSURE OR STRESS		
Inches of mercury	3.377	kilopascals (kPa)
Pounds/sq. in.	6.895	kilopascals
ENERGY OR WORK		
BTU	1 055.	joules (J)
Foot-pound	1.355	joules
Kilowatt-hour	3 600 000. or 3.6x10^6	joules (J = one W's)
LIGHT		
Foot candle	10.764	lumens/meter^2 (lm/m^2)
FUEL PERFORMANCE		
Miles/gal	0.425	kilometers/liter (km/l)
Gal/mile	2.352	liters/kilometer (l/km)
VELOCITY		
Miles/hour	1.609	kilometer/hr. (km/h)

Figure OA-13 Metric Information, Chart D

DECIMAL AND METRIC EQUIVALENTS

Fractions	Decimal In.	Metric MM.	Fractions	Decimal In.	Metric MM.
1/64	.015625	.39688	33/64	.515625	13.09687
1/32	.03125	.79375	17/32	.53125	13.49375
3/64	.046875	1.19062	35/64	.546875	13.89062
1/16	.0625	1.58750	9/16	.5625	14.28750
5/64	.078125	1.98437	37/64	.578125	14.68437
3/32	.09375	2.38125	19/32	.59375	15.08125
7/64	.109375	2.77812	39/64	.609375	15.47812
1/8	.125	3.1750	5/8	.625	15.87500
9/64	.140625	3.57187	41/64	.640625	16.27187
5/32	.15625	3.96875	21/32	.65625	16.66875
11/64	.171875	4.36562	43/64	.671875	17.06562
3/16	.1875	4.76250	11/16	.6875	17.46250
13/64	.203125	5.15937	45/64	.703125	17.85937
7/32	.21875	5.55625	23/32	.71875	18.25625
15/64	.234375	5.95312	47/64	.734375	18.65312
1/4	.250	6.35000	3/4	.750	19.05000
17/64	.265625	6.74687	49/64	.765625	19.44687
9/32	.28125	7.14375	25/32	.78125	19.84375
19/64	.296875	7.54062	51/64	.796875	20.24062
5/16	.3125	7.93750	13/16	.8125	20.63750
21/64	.328125	8.33437	53/64	.828125	21.03437
11/32	.34375	8.73125	27/32	.84375	21.43125
23/64	.359375	9.12812	55/64	.859375	21.82812
3/8	.375	9.52500	7/8	.875	22.22500
25/64	.390625	9.92187	57/64	.890625	22.62187
13/32	.40625	10.31875	29/32	.90625	23.01875
27/64	.421875	10.71562	59/64	.921875	23.41562
7/16	.4375	11.11250	15/16	.9375	23.81250
29/64	.453125	11.50937	61/64	.953125	24.20937
15/32	.46875	11.90625	31/32	.96875	24.60625
31/64	.484375	12.30312	63/64	.984375	25.00312
1/2	.500	12.70000	1	1.00	25.40000

Figure OA-14 Metric Information, Chart E

LIST OF AUTOMOTIVE ABBREVIATIONS WHICH MAY BE USED IN THIS MANUAL

A-6 - Axial 6 Cyl. A/C Compressor
A/C - Air Conditioning
Adj. - Adjust
A/F - Air/Fuel (As in Air/Fuel Ratio)
AIR - Air Injection Reaction System
ALC - Automatic Level Control
ALCL - Assembly Line Communications Link
Alt. - Altitude
AMP - Ampere(s)
APT - Adjustable Part Throttle
APS - Absolute Pressure Sensor
AT - Automatic Transmission/Transaxle
ATC - Automatic Temperature Control
ATDC - After Top Dead Center

BARO - Barometric Absolute Pressure Sensor
Bat. - Battery
Bat. + - Positive Terminal
Bbl. - Barrel
BCM - Body Control Module
BHP - Brake Horsepower
BP - Back Pressure
BTDC - Before Top Dead Center

Cat. Conv. - Catalytic Converter
CC - Cubic Centimeter
- Converter Clutch
CCC - Computer Command Control
C-4 - Computer Controlled Catalytic Converter
CB - Citizens Band (Radio)
CCOT - Cycling Clutch (Orifice) Tube
CCP - Controlled Canister Purge
CEAB - Cold Engine Airbleed
CEMF - Counter Electromotive Force
CID - Cubic Inch Displacement
CLOOP - Closed Loop
CLCC - Closed Loop Carburetor Control
CLTBI - Closed Loop Throttle Body Injection
CO - Carbon Monoxide
Conv. - Converter
CP - Canister Purge
CTS - Coolant Temperature Sensor
Cu. In. - Cubic Inch
CV - Constant Velocity
Cyl. - Cylinder(s)

DBB - Dual Bed Bead
DBM - Dual Bed Monolith
Diff. - Differential
Distr. - Distributor

EAC - Electric Air Control Valve
EAS - Electric Air Switching Valve
ECC - Electronic Comfort Control
ECM - Electronic Control Module
ECS - Emission Control System
ECU - Engine Calibration Unit
EEC - Evaporative Emission Control
EEVIR - Evaporator Equalized Valves in Receiver
EFE - Early Fuel Evaporation
EFI - Electronic Fuel Injection
EGR/TVS - Exhaust Gas Recirculation/ Thermostatic Vacuum Switch
ELC - Electronic Level Control
EMF - Electromotive Force
EMR - Electronic Module Retard
EOS - Exhaust Oxygen Sensor
ESC - Electronic Spark Control
EST - Electronic Spark Timing
ETC - Electronic Temperature Control
ETCC - Electronic Touch Comfort Control
ETR - Electronically Tuned Receiver
Exh. - Exhaust

Fed. - Federal (All States Exc. Calif.)
FMVSS - Federal Motor Vehicle Safety Standards
Ft. Lb. - Foot Pounds (Torque)
FWD - Front Wheel Drive
- Four Wheel Drive
4 x 4 - Four Wheel Drive

HC - Hydrocarbons
HD - Heavy Duty
HEI - High Energy Ignition
Hg. - Mercury
Hi. Alt. - High Altitude
HVAC - Heater-Vent-Air Conditioning
HVACM - Heater-Vent-Air Conditioning Module
HVM - Heater-Vent-Module

IAC - Idle Air Control
IC - Integrated Circuit
ID - Identification
- Inside Diameter
IGN- Ignition
INJ. - Injection
ILC - Idle Load Compensator
I/P - Instrument Panel
ISC - Idle Speed Control

km - Kilometers
km/hr - Kilometers Per Hour
KV - Kilovolts (Thousands of Volts)
km/L - Kilometers/Liter (mpg)
kPa - Kilopascals

L - Liter
L-4 - Four Cylinder In-Line (Engine)
L-6 - Six Cylinder In-Line (Engine)
LF - Left Front
LR - Left Rear

MAF - Mass Air Flow
Man. Vac. - Manifold Vacuum
MAP - Manifold Absolute Pressure
MAT - Manifold Air Temperature Sensor
M/C - Mixture Control
MPG - Miles Per Gallon
MPFI - Multi-Port Fuel Injection
MPH - Miles Per Hour
MT - Manual Transmission
MV - Milli Volt

N·m - Newton Metres (Torque)
NO_x - Nitrogen, Oxides of

OD - Outside Diameter
OHC - Overhead Cam
OL - Open Loop
OXY - Oxygen
0_2 - Oxygen (Sensor)

PAIR - Pulse Air Injection Reaction System
P/B - Power Brakes
PCV - Positive Crankcase Ventilation
PECV - Power Enrichment Control Valve
PFI - Port Fuel Injection
P/N - Park, Neutral
PROM - Programmable, Read Only Memory
P/S - Power Steering
PSI - Pounds Per Square Inch
Pt. - Pint
PTO - Power Takeoff

Qt. - Quart

R - Resistance
R-4 - Radial Four Cyl. A/C Compressor
Ref. - Reference
RF - Right Front
RPM - Revolutions Per Minute
RPO - Regular Production Option
RR - Right Rear
RTV - Room Temperature Vulcanizing (Sealer)
RVR - Response Vacuum Reducer
RWD - Rear Wheel Drive

SAE - Society of Automotive Engineers
SI - System International
Sol. - Solenoid
Syn. - Synchronizer

TAC - Thermostatic Air Cleaner
TACH - Tachometer
TBI - Throttle Body Injection
TCC - Transmission Converter Clutch
TCS - Transmmission Controlled Spark
TDC - Top Dead Center
TPS - Throttle Position Sensor
TURB - Turbocharger
T/V - Throttle Valve
TVBV - Turbocharger Vacuum Bleed Valve
TVRS - Television & Radio Suppression
TVS - Thermal Vacuum Switch

UJT - Universal Joint

V - Volt(s)
V-6 - Six Cylinder Engine - Arranged in a "V"
V-8 - Eight Cylinder Engine - Arranged in a "V"
Vac. - Vacuum
VATS - Vehicle Anti-Theft System
VIN - Vehicle Identification Number
VIR - Valves in Receiver
VMV - Vacuum Modulator Valve
V-REF - ECM Reference Voltage
VSS - Vehicle Speed Sensor

W/ - With
W/B - Wheel Base
W/O - Without
WOT - Wide Open Throttle

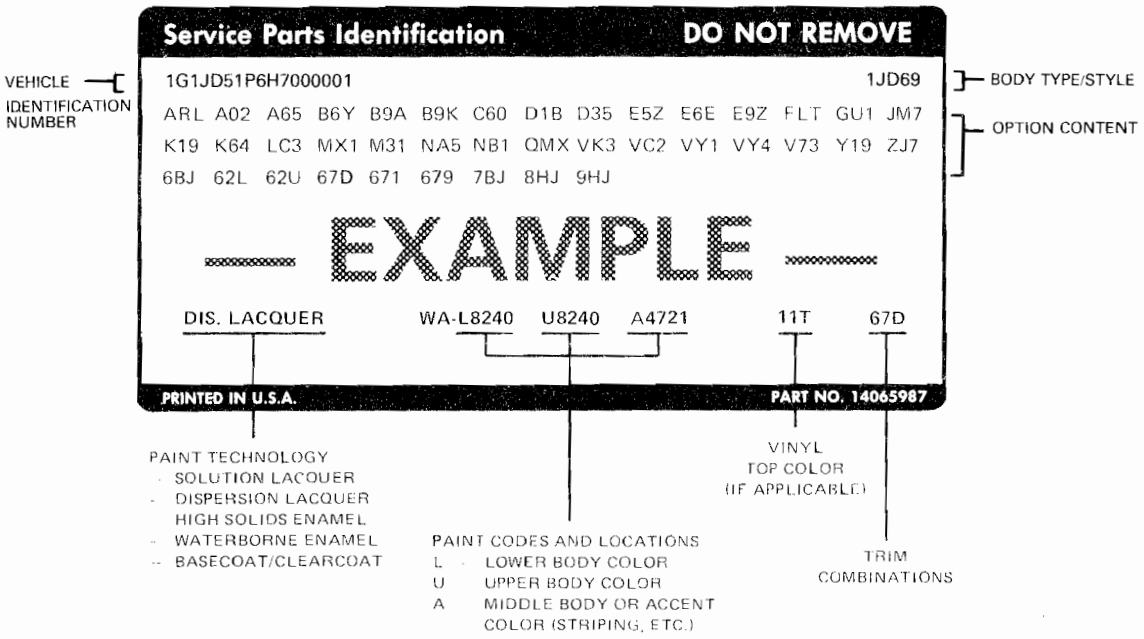
X-Valve - Expansion Valve

Figure OA-15 Common Abbreviations

SERVICE PARTS IDENTIFICATION LABEL

The Service Parts Identification Label provides identification of vehicle equipment to assist in servicing and determining replacement parts. Included on this label will be regular production options (RPO's) as well as standard and mandatory options. The label will be affixed to the inside of each passenger car vehicle at the assembly plant.

For additional information on the Service Parts Identification Label, see a GM Parts Catalog.



LABEL LOCATION

CORVETTE

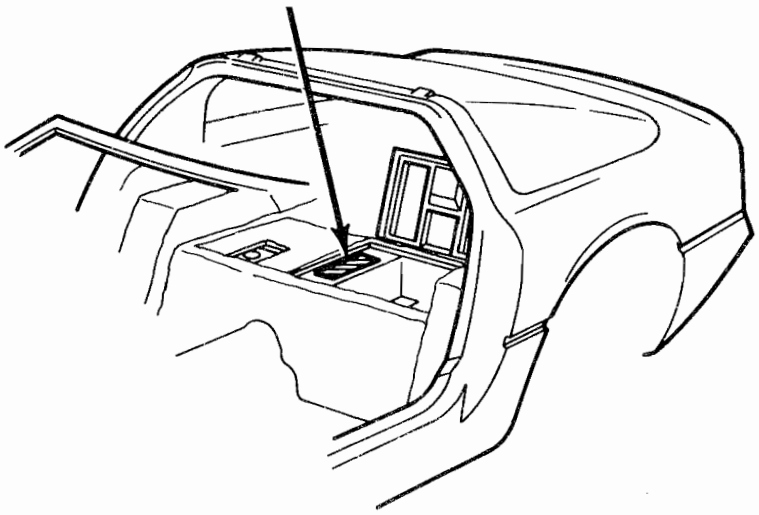


Figure OA-16 Service Parts Identification Label

SECTION 0B
MAINTENANCE AND LUBRICATION

CONTENTS

Maintenance Schedule, Gasoline 0B-1
Maintenance Schedules I and II 0B-2
Owner Inspections 0B-3
Recommended Fluids and Lubricants 0B-6

PASSENGER CAR MAINTENANCE SCHEDULE
VEHICLES WITH GASOLINE ENGINE

NORMAL CAR USE

The maintenance services contained in Schedules I and II are based on the assumption that your car will be used as designed:

- To carry passengers and cargo within the limits shown on the Tire Placard located on the edge of the driver's door.
- On reasonable road surfaces within legal driving limits.
- On unleaded gasoline.

EXPLANATION OF SCHEDULED MAINTENANCE SERVICES

The services listed in Maintenance Schedules I and II are further explained below. When the following maintenance services are performed, make sure all parts are replaced and all necessary repairs are done before driving your car. Be sure to use the proper fluid and lubricants as shown in Figure 0B-2.

ITEM 1

Engine Oil and Oil Filter Change*

ALWAYS USE SF/CC OR SF/CD ENERGY CONSERVING OILS OF PROPER VISCOSITY — Also, always change oil and filter as soon as possible after driving in a dust storm. See your Owner's Manual for further details.

ITEM 2

Chassis Lubrication

Lubricate all grease fittings in suspension and steering linkage. Lubricate transmission/transaxle shift linkage, parking brake cable guides, underbody contact points and linkage. Also lubricate clutch cross shaft lever every 30,000 miles (50 000 km) on rear-wheel-drive cars only.

ITEM 3

Carburetor Choke and Hoses*

If your car is equipped with a carburetor, verify that choke and vacuum break work properly and are within specifications. Correct any binding caused by damage or gum on the choke shaft. Inspect hoses for proper hookup, cracks, chafing or decay. Correct as necessary.

ITEM 4

Carburetor or Throttle Body Mounting Bolt Torque*

Check torque of mounting bolts and/or nuts.

ITEM 5

Engine Idle Speed Adjustment*

(Engines without Idle Speed Control or Idle Air Control) — Adjust to specifications shown on the underhood label. If no specifications are shown on the label, no adjustment is necessary. Calibrated test equipment must be used.

ITEM 6

Tire and Wheel Rotation

To equalize wear and obtain maximum tire life, rotate in accordance with patterns shown in Owner's Manual.

ITEM 7

Vacuum or A.I.R. Pump Drive Belt Inspection*

When a separate belt is used to drive the vacuum or A.I.R. pump, inspect it for cracks, fraying, wear and proper tension. Adjust or replace as needed.

ITEM 8

Cooling System Service*

Drain, flush and refill system with new coolant. See your Owner's Manual for further details.

ITEM 9

Wheel Bearing Repack (Rear-Wheel-Drive Cars Only Except Corvette)

Clean and repack front wheel bearings at each brake relining or 15,000 miles (25 000 km), whichever comes first, when car is used in such service as police, taxi or door-to-door delivery. If you do not use your car in such service, clean and repack bearings at each brake relining or 30,000 miles (50 000 km), whichever comes first. Corvette models do not require wheel bearing repack.

**An Emission Control Service*

Select and follow Schedule I or Schedule II based on how you use your car:

SCHEDULE I

Follow Schedule I if your car is mainly operated under one or more of the following conditions:

- When most trips are less than 4 miles (6 kilometers).
- When most trips are less than 10 miles (16 kilometers) and outside temperatures remain below freezing.
- Idling and/or low speed operation in stop-and-go traffic.
- Towing a trailer.
- Operating in dusty areas.

Schedule I should also be followed if the car is used for delivery service, police, taxi or other commercial applications.

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Miles (kilometers) or Months, Whichever Occurs First	The services shown in this schedule up to 48,000 miles (80 000 km) are to be performed after 48,000 miles at the same intervals.														
		MILES (000)	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
		KILOMETERS (000)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
1	Engine Oil & Oil Filter Change*	Every 3,000 miles (5 000 km) or 3 months	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
2	Chassis Lubrication	Every other oil change		•		•		•		•		•		•		•		•
3	Carburetor Choke & Hose Inspection* (if equipped)	At 6,000 miles (10 000 km), and then every 30,000 miles (50 000 km)		•								•**						
4	Carburetor or Throttle Body Mounting Bolt Torque*	At 6,000 miles (10 000 km) only		•**														
5	Engine Idle Speed Adjustment (Some Models)*			•**														
6	Tire & Wheel Rotation	At 6,000 miles (10 000 km) and then every 15,000 miles (25 000 km)		•					•					•				
7	Vacuum or A.I.R. Pump Drive Belt Inspection*	Every 30,000 miles (50 000 km) or 24 months										•**						
8	Cooling System Service*											•						
9	Wheel Bearing Repack (Rear-Wheel Drive Cars Only)	See Explanation for Service Interval.																
10	Transmission Transaxle Service																	
11	Vacuum Advance System Inspection (Some Models)*	Every 30,000 miles (50 000 km)										•						
12	Spark Plug and Wire Service*											•**						
13	PCV Valve Inspection*											•						
14	EGR System Service*	Every 30,000 miles (50 000 km) or 36 months										•						
15	Air Cleaner & PCV Filter Replacement*											•**						
16	Engine Timing Check*	Every 30,000 miles (50 000 km)										•						
17	Fuel Tank, Cap & Lines Inspection*											•						
18	Thermostatically Controlled Air Cleaner Inspection*											•						

SCHEDULE II

Follow Schedule II **only** if none of the driving conditions specified in Schedule I apply.

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Miles (kilometers) or Months, Whichever Occurs First	The services shown in this schedule up to 45,000 miles (75 000 km) are to be performed after 45,000 miles at the same intervals					
		MILES (000)	7.5	15	22.5	30	37.5	45
		KILOMETERS (000)	12.5	25	37.5	50	62.5	75
1	Engine Oil Change* (Turbocharged, see †)	Every 7,500 miles (12 500 km) or 12 months	•	•	•	•	•	•
	Oil Filter Change*†	At first and then every other oil change or 12 months	•		•		•	
2	Chassis Lubrication	Every 7,500 miles (12 500 km) or 12 months	•	•	•	•	•	•
3	Carburetor Choke & Hose Inspection*	At 7,500 miles (12 500 km) and then every 30,000 miles (50 000 km)	•			•**		
4	Carburetor or Throttle Body Mounting Bolt Torque*	At 7,500 miles (12 500 km) only	•**					
5	Engine Idle Speed Adjustment (Some Models)*		•**					
6	Tire & Wheel Rotation	At 7,500 miles (12 500 km) and then every 15,000 miles (25 000 km)	•		•		•	
7	Vacuum or A.I.R. Pump Drive Belt Inspection*	Every 30,000 miles (50 000 km) or 24 months				•**		
8	Cooling System Service*					•		
9	Wheel Bearing Repack (Rear-Wheel Drive Cars Only)	Every 30,000 miles (50 000 km)				•		
10	Transmission Transaxle Service	See Explanation for Service Interval.						
11	Vacuum Advance System Inspection (Some Models)*	Every 30,000 miles (50 000 km)				•		
12	Spark Plug and Wire Service*					•**		
13	PCV Valve Inspection*					•		
14	EGR System Service*	Every 30,000 miles (50 000 km) or 36 months				•		
15	Air Cleaner & PCV Filter Replacement*					•**		
16	Engine Timing Check* (Some Models)	Every 30,000 miles (50 000 km)				•		
17	Fuel Tank, Cap & Lines Inspection*					•		
18	Thermostatically Controlled Air Cleaner Inspection*					•		

FOOTNOTES:

* *An Emission Control Service.*

** *In California, these are the minimum Emission Control Maintenance Services an owner must perform according to the California Air Resources Board. General Motors, however, urges that all Emission Control Maintenance Services shown be performed. To maintain your other new car warranties, all services shown in this section should be performed.*

† *Turbocharged Engines*

• *VIN engine code M — change oil every 3,000 miles (5,000 km) or 3 months, whichever comes first. Change engine oil filter at first oil change, then every other oil change.*

• *VIN engine code 7 — change oil and filter every 7,500 miles (12 500 km) or 12 months, whichever comes first.*

***NOTE**: To determine engine code and displacement, see the Specifications Section of your Owner's Manual.*

Figure 0B-1 Maintenance Schedules I and II — Gasoline Vehicles

ITEM 10

Transmission/Transaxle Service

The manual transmission or transaxle fluid does not require changing. (Corvette only.) Change fluid in overdrive unit every 30,000 miles (50 000 km).

For automatic transmissions or transaxles, change both the fluid and filter every 15,000 miles (25 000 km) if the car is mainly driven under one or more of these conditions:

- In heavy city traffic where the outside temperature regularly reaches 90°F (32°C) or higher.
- In hilly or mountainous terrain.
- Frequent trailer pulling.
- Uses such as found in taxi, police car or delivery service.

If you do not use your car under any of these conditions, change both the fluid and filter every 100,000 miles (160 000 km). See you Owner's Manual for further details.

ITEM 11

Vacuum Advance System Inspection*

Applies only to Canadian vehicles without Computer Command Control and Chevette and T1000 non-California models. Check system for proper operation. Check hoses for proper hookup, cracks, chafing or decay. Replace parts as needed.

ITEM 12

Spark Plug and Wire Service*

Replace spark plugs with type listed in your Owner's Manual. Clean wires and inspect for burns, cracks or other damage. Check the wire boot fit at distributor and at spark plugs. Replace wires as needed.

ITEM 13

Positive Crankcase Ventilation (PCV) Valve Inspection*

Inspect valve for proper function. Replace valve if necessary as well as any worn, plugged or collapsed hoses.

ITEM 14

EGR System Service*

Conduct EGR System Service as referenced in the EGR System Chart shown in the appropriate 6E Section. Also, refer to your GM maintenance schedule booklet for specific applications.

ITEM 15

Air Cleaner and PCV Filter Replacement*

On 1.6 and 2.0 liter engines, replace every 50,000 miles (80 000 km). On all other engines, replace every 30,000 miles (50 000 km). Replace more often under dusty conditions. Ask your dealer for the proper replacement interval for your driving conditions.

**An Emission Control Service*

ITEM 16

Engine Timing Check*

Adjust timing to underhood label specifications. If no specifications are shown, no adjustment is needed.

ITEM 17

Fuel Tank, Cap and Lines Inspection*

Inspect fuel tank, cap and lines (including fuel rails and injection assembly, if so equipped) for damage or leaks. Inspect fuel cap gasket for an even filler neck imprint or any damage. Replace parts as needed.

ITEM 18

Thermostatically Controlled Air Cleaner Inspection*

If your car is equipped, inspect all hoses and ducts for proper hookup. Make sure valve works properly.

OWNER INSPECTIONS AND SERVICES

Listed below are inspections and services which should be made by either you or a qualified technician at the intervals shown to help ensure proper safety, emission performance and dependability of your car. Take any problems promptly to your dealer or another qualified technician for service advice. Whenever repairs are necessary, have them completed at once. For your safety and that of others, any safety-related parts that could have been damaged in an accident should be inspected and all needed repairs should be done before operating your car. Be sure to use the proper fluids and lubricants as shown in Figure 0B-2.

WHILE OPERATING YOUR VEHICLE

Automatic transmission/transaxle shift indicator operation — Make sure the indicator points to the gear chosen.

Horn operation — Blow the horn occasionally to make sure it works. Check all button locations.

Brake system operation — Be alert to abnormal sounds, increased brake pedal travel or repeated pulling to one side when braking. Also, if a brake warning light comes on or flashes, or the anti-lock warning light (if equipped) comes on or remains on, something may be wrong with part of the brake system. Have it inspected and repaired at once.

Exhaust system operation — Be alert to any changes in the sound of the system or any smell of fumes. These are signs the system may be leaking or overheating. Have it inspected and repaired at once. Also see "Engine Exhaust Gas Caution (Carbon Monoxide)" and "Catalytic Converter" in your Owner's Manual.

Tire and wheel operation — Be alert to a vibration of the steering wheel or seat at normal highway speeds. This may mean a wheel balance is needed. Also, a pull right or left on a straight, level road may show the need for a tire pressure adjustment or wheel alignment.

Steering system operation — Be alert to changes in steering action. An inspection is needed when the steering wheel is harder to turn or has too much free play or if unusual sounds are noted when turning or parking.

Headlight aim operation — Take note of light pattern occasionally. If beam aim doesn't look right, headlights should be adjusted.

AT EACH FUEL FILL

Engine oil level check — Check engine oil level and add if necessary. See your Owner's Manual for further details.

NOTICE: A large loss in this system may indicate a problem. Have it inspected and repaired at once.

Engine coolant level and condition — Check engine coolant level in coolant reservoir tank and add if necessary. Replace if dirty or rusty. See your Owner's Manual for further details.

NOTICE: A large loss in this system may indicate a problem. Have it inspected and repaired at once.

Windshield washer fluid level check — Check washer fluid level in container and add if necessary.

Hood latch operation — When opening hood on cars equipped with hoods that open from the front, note the operation of secondary latch. It should keep hood from opening all the way when primary latch is released. Make sure that hood closes firmly.

AT LEAST MONTHLY

Tire and wheel inspection and pressure check — Check tires for abnormal wear or damage. Also, check for damaged wheels. Keep pressures as shown on Tire Placard on the driver's door (include spare unless it is a stowaway). Pressure should be checked when tires are "cold". See "Tires" in Owner's Manual for further information.

Light operation check — Check operation of license plate light, side-marker lights, headlights including high beams, parking lights, taillights, brake lights, turn signals, backup lights, instrument panel and interior lights and hazard warning flashers.

Fluid leak check — After the car has been parked for a while, inspect the surface beneath the car for water, oil, fuel or other fluids. Water dripping from the air conditioning system after use is normal. If you notice fuel leaks or fumes, the cause should be found and corrected at once.

AT LEAST TWICE A YEAR (FOR EXAMPLE, EVERY SPRING AND FALL)

Power steering pump fluid level check — Check power steering pump fluid level in accordance with Owner's Manual instructions and keep at proper level.

NOTICE: A large loss in this system may indicate a problem. Have it inspected and repaired at once.

Brake master cylinder reservoir fluid level check — Check fluid and keep at proper level. Note: It is normal for the brake fluid level to go down slightly as the brake pads wear — so be sure to keep reservoir filled.

NOTICE: A large loss in this system may indicate a problem. Have it inspected and repaired at once.

Clutch system service — manual transmission/transaxle — For cars equipped with hydraulic clutch system, check the reservoir fluid level and add fluid as required. All others, check clutch pedal free travel and adjust as necessary. See your Owner's Manual for further details.

NOTICE: A large loss in this system may indicate a problem. Have it inspected and repaired at once.

Weatherstrip Lubrication — Clean surface and then apply a thin film of silicone grease with a clean cloth.

EACH TIME OIL IS CHANGED

Automatic and manual transmission/transaxle fluid level check — Check transmission/transaxle fluid level and add as required. (Corvette only) if equipped with manual transmission — check fluid in the overdrive unit and add as required.

NOTICE: A large loss in this system may indicate a problem. Have it inspected and repaired at once.

Brake systems inspection — For convenience, the following should be done when wheels are removed for rotation: Inspect lines and hoses for proper hookup, binding, leaks, cracks, chafing, etc. Inspect disc brake pads for wear and rotors for surface condition. Also inspect drum brake linings for wear and cracks. Inspect other brake parts, including drums, wheel cylinders, parking brake, etc. at the same time. Check parking brake adjustment.

INSPECT BRAKES MORE OFTEN IF DRIVING HABITS OR CONDITIONS RESULT IN FREQUENT BRAKING.

Steering, suspension and front drive axle boot and seal inspection — Inspect front and rear suspension and steering system for damaged, loose or missing parts, signs of wear or lack of lubrication. Inspect power steering lines and hoses for proper hookup, binding, leaks, cracks, chafing, etc. (On cars equipped with manual steering gear, check for seal leakage.) On front-wheel-drive cars, clean then inspect drive axle boot seals for damage, tears or leakage. Replace seals if necessary.

Exhaust system inspection — Inspect complete system. Inspect body near the exhaust system. Look for broken, damaged, missing or out-of-position parts as well as open seams, holes, loose connections or other conditions which could cause a heat buildup in the floor pan or could let exhaust fumes seep into the trunk or passenger compartment.

Throttle linkage inspection — Inspect for interference, binding, damaged or missing parts.

Engine drive belts inspection — Inspect all belts for cracks, fraying and wear. Adjust or replace as needed.

Rear axle service (if equipped) — Check gear lubricant level and add if needed. For cars equipped with a limited slip rear axle, fluid does not require changing (except Caprice and Corvette — change fluid and required additive at first 7,500 miles (12 500 km). See your Owner's Manual or "Recommended Fluids & Lubricants Chart" in this section.

IF YOU USE YOUR CAR TO PULL A TRAILER, CHANGE GEAR LUBRICANT EVERY 7,500 MILES (12 500 KM).

NOTICE: A large loss in this system may indicate a problem. Have it inspected and repaired at once.

Power antenna — Clean and then lubricate power antenna mast. The proper lubricant as shown in Figure OB-2 should be used.

AT LEAST ONCE A YEAR

Lap and shoulder belts condition and operation — Inspect belt system, including webbing, buckles, latch plates, retractors, guide loops and anchors.

Moveable head restraint operation — On cars with moveable restraints, make sure restraints stay in the desired position. (See adjustment instructions in your Owner's Manual.)

Seatback latch and recliner operation on cars equipped with recliner seat — Be sure seatbacks latch on those cars with folding seats using mechanical latches. Make sure the recliner is holding by pushing and pulling on the top of the seatback while it is reclined. See your Owner's Manual for seat operating information.

Spare tire and jack storage — Be alert to rattles in rear of car. Make sure the space tire, all jacking equipment, any tire inflator and any covers or doors are securely stowed at all times. Oil jack ratchet or screw mechanism after each use.

Key lock service — Lubricate key lock cylinder at least annually.

Body lubrication service — Lubricate all body door hinges including the tailgate or hatchback lid (if equipped). Also lubricate the body hood, fuel door and rear compartment hinges and latches including interior glove box and counsel doors, and any folding seat hardware.

Transmission/transaxle neutral or clutch start switch operation

CAUTION: Before performing the following safety switch check, be sure to have enough room around the car. Then, firmly apply both the parking brake (see your Owner's Manual for procedure) and the regular brakes. Do not use the accelerator pedal. If the engine starts, be ready to turn off the ignition promptly. Take these precautions because the car could move without warning and possibly cause personal injury or property damage. On automatic transmission/transaxle cars, try to start the engine in each gear. The starter should crank only in "Park" or "Neutral." On manual transmission/transaxle cars, place the shift lever in "Neutral," push the clutch halfway and try to start. The starter should crank only when the clutch is fully depressed.

Steering column lock operation — While parked, try to turn key to "Lock" in each gear range. The key should turn to "Lock" only when gear is in "Park" on automatic or "Reverse" on manual transmission/transaxle. On cars with key release lever, try to turn key to "Lock" without depressing the lever. The key should turn to "Lock" only with the key lever depressed. On all vehicles, the key should come out only in "Lock."

Parking brake and transmission/transaxle "Park" mechanism operation

CAUTION: Before checking the holding ability of the parking brake and automatic transmission/transaxle "Park" mechanism, park on a fairly steep hill with enough room for movement in the downhill direction. To reduce the risk of personal injury or property damage, be prepared to apply the regular brakes promptly if the car begins to move.

To check the parking brake, with the engine running and transmission/transaxle in "Neutral," slowly remove foot pressure from the regular brake pedal (until the car is held by only the parking brake).

To check the automatic transmission/transaxle "Park" mechanism holding ability, release all brakes after shifting the transmission/transaxle to "Park."

Underbody flushing — At least every spring, flush from the underbody with plain water any corrosive materials used for ice and snow removal and dust control. Take care to thoroughly clean any areas where mud and other debris can collect. Sediment packed in closed areas of the vehicle should be loosened before being flushed.

Engine cooling system service — Inspect coolant and freeze protection. If dirty or rusty, drain, flush and refill with new coolant. Keep coolant at the proper mixture as specified in your Owner's Manual. This provides proper freeze protection, corrosion inhibitor level and engine operating temperature. Inspect hoses and replace if cracked, swollen or deteriorated. Tighten hose clamps. Clean outside of radiator and air conditioning condensor. Wash radiator filler cap and neck. To help ensure proper operation, a pressure test of both the cooling system and cap is also recommended. (See maintenance schedule charts in Figure 0B-1 for the recommended coolant change interval.)

NOTE: Fluids and lubricants identified below by name, part number or specification may be obtained from your GM dealer.

USAGE	FLUID/LUBRICANT
Engine Oil	GM Goodwrench Motor Oil or equivalent for API Service, SF/CC or SF/CD of the recommended viscosity
Engine Coolant	Mixture of water and good quality ethylene glycol base antifreeze conforming to GM spec. 1825M (GM Part No. 1052753)
Brake and Hydraulic Clutch Systems	Delco Supreme 11 Fluid (GM Part No. 1052535) or DOT-3 Fluid
Parking Brake Cables	Chassis grease meeting requirements of GM-6031M (GM Part No. 1052497)
Power Steering System	GM power steering fluid, Part No. 1052884 or equivalent.
Manual Steering Gear (recirculating ball)	Use lubricant meeting requirements of GM-4673M (GM Part No. 1052182)
Automatic Transmission/Transaxle and 5 Speed Manual Transmissions	DEXRON®-II Automatic Transmission Fluid (GM Part No. 1051855) Camaro and Firebird (5 Speed) — Manual Transaxle Fluid (GM Part No. 1052931)
Manual Transaxle	SAE 5W-30 (GM Part No. 1052931) Manual Transaxle Fluid
Manual Transmission (rear-wheel-drive) 4 Speed	Corvette overdrive unit — DEXRON®-II. All others SAE-80W-90 GL-5 gear lubricant (GM Part No. 1052271)
Manual Transmission/Transaxle Shift Linkage	Chassis grease meeting requirements of GM-6031M (GM Part No. 1052497)
Key Lock Cylinders	Black Key Lock Cylinders — light oil (GM Part No. 1052949) All other Key Lock Cylinders — silicone lubricant (GM Part No. 1052277)
Automatic Transmission/Transaxle Shift Linkage	Engine Oil
Clutch Linkage Pivot Points	Engine Oil
Floor Shift Linkage	Engine Oil
Power Antenna Mast (3-mast section-type only)	Light Oil (GM Part No. 1052949)
Chassis Lubrication	Chassis grease meeting requirements of GM-6031M (GM Part No. 1052497)
Standard Differential Rear Axle	SAE 80W or SAE 80W-90 GL-5 (SAE 80W GL-5 in Canada) gear lubricant (GM Part No. 1052271)
Limited-Slip Differential Rear Axle	**For Camaro only** — Use SAE 80W/90 GL-5+ Hypoid Oil (GM Part No. 1050010), if equipped w/5.7L (L98) Engine **or** 5.0L (LB9) engine w/5-speed manual transmission and disc brakes. **All other applications** — Use SAE 80W or SAE 80W-90 GL-5 Gear Lubricant (GM Part No. 1052271).
Windshield Washer Solvent	GM Optikleen Washer Solvent (GM Part No. 1051515) or equivalent
Hood Latch Assembly a) Pivots and Spring Anchor b) Release Pawl	a) Engine Oil b) Chassis grease meeting requirements of GM-6031M (GM Part No. 1052497)
Front Wheel Bearings (rear-wheel-drive)	Lubricant GM Part No. 1051344 grease or equivalent
Hood and door hinges, station wagon tailgate hinge or hatchback lid and linkage, headlight door assemblies, station wagon rear folding seat, fuel door hinge, rear compartment lid hinges	Engine Oil
Weatherstrips	Silicone Grease (GM Part No. 1052863) or equivalent

Figure 0B-2 Recommended Fluids and Lubricants

SECTION 1B
AIR CONDITIONING

NOTICE: When performing air conditioning diagnosis on vehicles equipped with a catalytic converter, it will be necessary to WARM the engine to a NORMAL operating temperature BEFORE attempting to idle the engine for periods greater than five (5) minutes. Once the choke is open and fast idle speed reduced to a normal idle, diagnosis and adjustments can be made.

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General Description

Both the heating and cooling functions are performed by this system. Air entering the vehicle must pass through the cooling unit (evaporator) and through (or around) the heating unit, in that order, and the system is thus referred to as a "reheat" system.

The evaporator provides maximum cooling of the air passing through the core when the air conditioning system is calling for cooling.

HANDLING REFRIGERANT-12

Air conditioning systems contain Refrigerant-12. This is a chemical mixture which requires special handling procedures to avoid personal injury.

Always wear goggles and wrap a clean cloth around fittings, valves and connections when performing work that involved opening the refrigerant system. Always work in a well ventilated area and do not weld or steam clean on or near any car installed air conditioning lines or components.

If Refrigerant-12 should come in contact with any part of the body, flush the exposed area with cold water and immediately seek medical help.

All Refrigerant-12 drums are shipped with a heavy metal screw cap. The purpose of the cap is to protect the valve and safety plug from damage. It is good practice to replace the cap after each use of the drum for this same reason.

If it is necessary to transport or carry any container of Refrigerant-12 in a vehicle, do not carry it in the passenger compartment.

If the occasion arises to fill a small Refrigerant-12 drum from a large one, never fill the drum completely. Space should always be allowed above the liquid for expansion.

1. Do not leave drum of Refrigerant-12 uncapped.
2. Do not carry any container of Refrigerant-12 in passenger compartment of car.
3. Do not subject any container of Refrigerant-12 to high temperature.
4. Do not weld or steam clean on or near system.
5. Do not fill drum of Refrigerant-12 completely.
6. Do not discharge vapor into area where flame is exposed.
7. Avoid breathing smoke and fumes produced by the burning of the Refrigerant-12. Such fumes may be hazardous.
8. One of the most important cautions concerns the eyes. Any liquid Refrigerant-12 which may accidentally escape is approximately 21°F (-6°C) below zero. If liquid Refrigerant-12 should touch the eyes, serious damage could result. Always wear goggles to protect the eyes when opening refrigerant connections. If Refrigerant-12 liquid should strike the eye:
   a. Call a doctor or eye specialist immediately and obtain treatment as soon as possible.
   b. DO NOT RUB THE EYE. Splash the affected area with quantities of cold water to gradually get the temperature above the freezing point.
   c. The use of an antiseptic oil is helpful in providing a protective film over the eyeball to

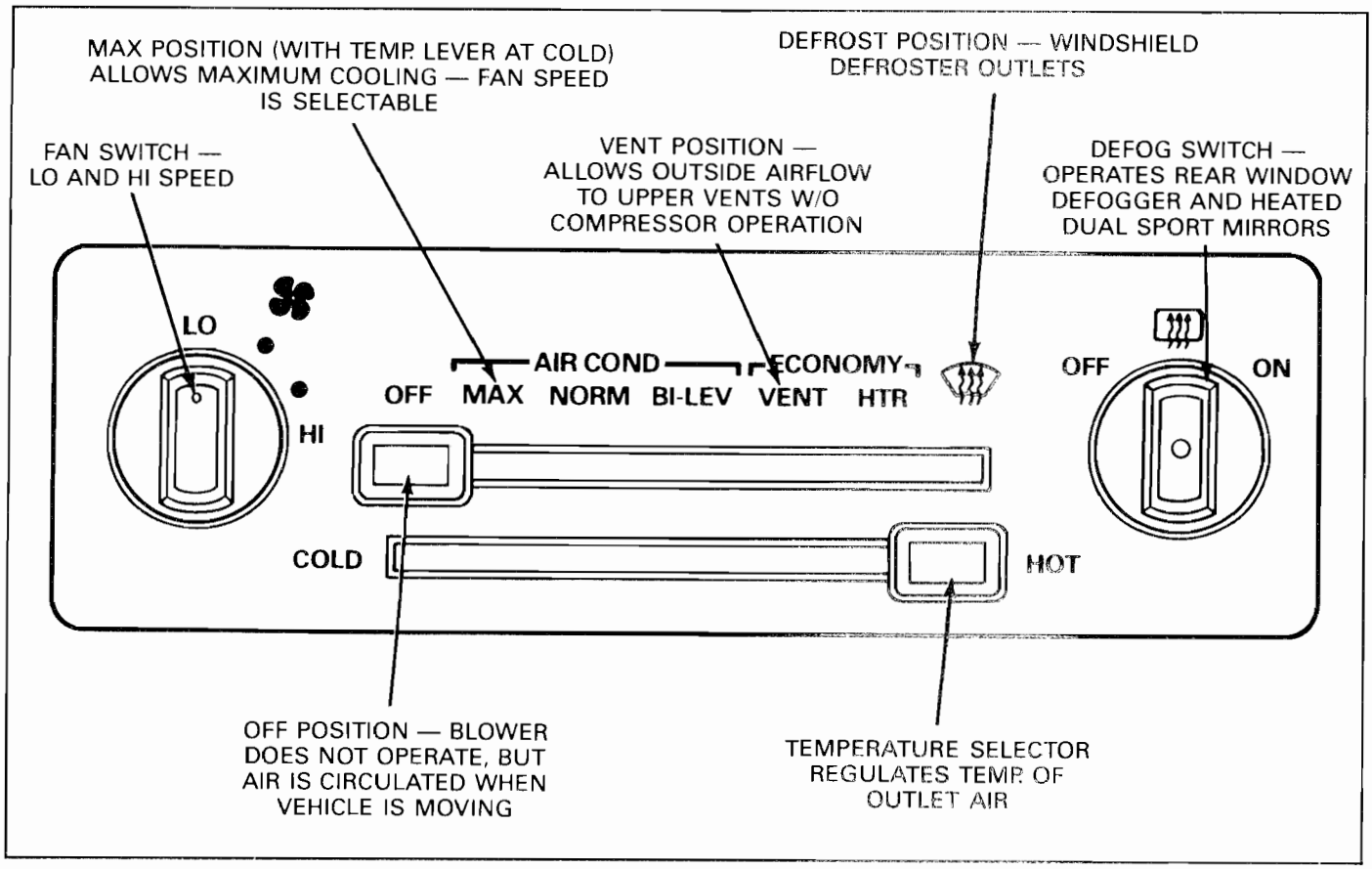
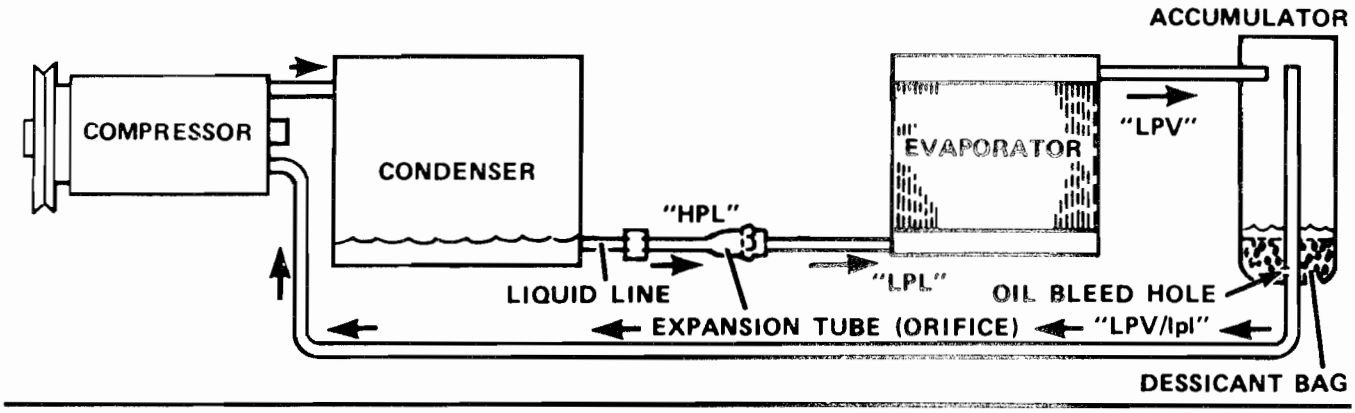


Fig. 1B-1--Air Conditioning Control



"HPV" – HIGH PRESSURE VAPOR LEAVING COMPRESSOR.

"HPL" – VAPOR IS COOLED DOWN BY CONDENSER AIR FLOW AND LEAVES AS HIGH PRESSURE LIQUID.

"LPL" – ORIFICE METERS THE LIQUID R-12, INTO EVAPORATOR, REDUCING ITS PRESSURE, AND WARM BLOWER AIR ACROSS EVAPORATOR CORE CAUSES BOILING OFF OF LIQUID INTO VAPOR.

"LPV" – LEAVES EVAPORATOR AS LOW PRESSURE VAPOR AND RETURNS WITH THE SMALL AMOUNT OF . . .

"lpl" – . . . LOW PRESSURE LIQUID THAT DIDN'T BOIL OFF COMPLETELY BACK TO THE COMPRESSOR TO BE COMPRESSED AGAIN.

5055

Fig. 1B-2--CCOT System Components

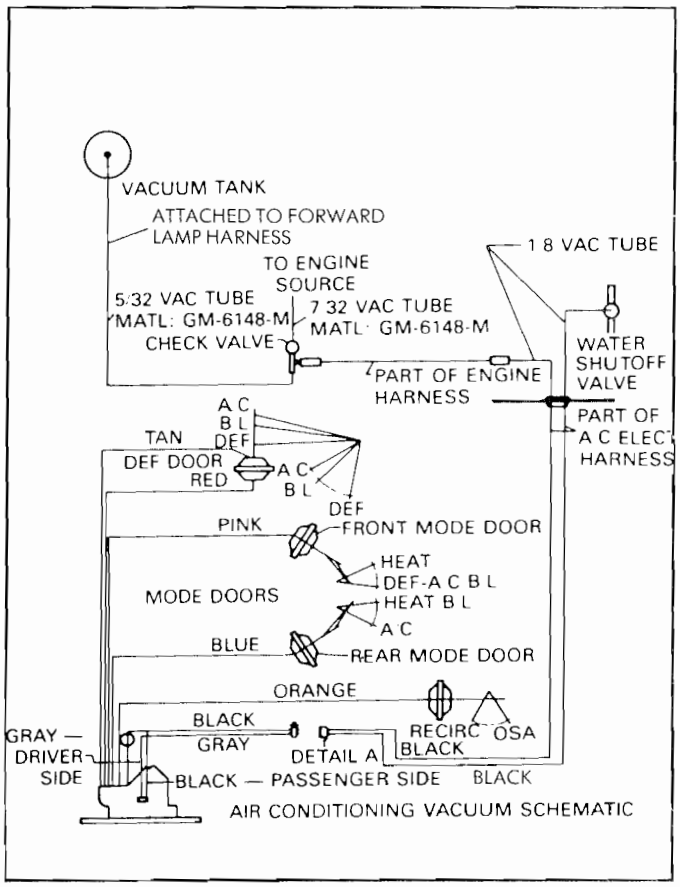


Fig. 1B-3--C60 A/C Vacuum Diagram

reduce the possibility of infection. Should liquid Refrigerant-12 come into contact with the skin, the injury should be treated the same as skin which has been frostbitten or frozen.

All Refrigerant-12 drums are shipped with a heavy metal screw cap. The purpose of the cap is to protect the valve and safety plug from damage. It is good practice to replace the cap after each use of the drum for the same reason.

If it is necessary to transport or carry any container of Refrigerant-12 in a car, keep it in the luggage compartment. If the drum is exposed to the radiant heat of the sun, the resultant increase in pressure may cause the safety plug to release or the drum to burst.

Welding or steam cleaning near any of the refrigerant lines or components of the air conditioning system could build up dangerous and damaging pressures in the system.

If the occasion arises to fill a small Refrigerant-12 drum from a large one, never fill the drum completely. Space should always be allowed above the liquid for expansion. If the Refrigerant-12 drum were completely full and the temperature was increased, tremendous hydraulic force could be developed.

REFRIGERANT CHARGE	2 3/4
OIL CHARGE	R4: 6 OZ.

Fig. 1B-5--A/C System Refrigerant Capacity

HANDLING OF REFRIGERANT LINES AND FITTINGS

Tighten all tubing connections as shown in Figure 6 Torque Chart. Insufficient or excessive torque when tightening can result in loose joints or deformed joint parts. Either condition can result in refrigerant leakage.

- All metal tubing lines should be free of dents or

METAL TUBE OUTSIDE DIAMETER	THREAD AND FITTING SIZE	ALUMINUM OR COPPER TUBING TORQUE LB. FT.	N·m	NOMINAL TORQUE WRENCH SPAN
1/4	7/16	5-7	7-9	5/8
3/8	5/8	11-13	15-18	3/4
1/2	3/4	15-20	20-27	7/8
5/8	7/8	21-27	29-37	1 1/16
3/4	1 1/16	28-33	38-45	1 1/4

Fig. 1B-6--Torque Chart

REFRIGERANT — 12
PRESSURE — TEMPERATURE RELATIONSHIP

The table below indicates the pressure of Refrigerant — 12 at various temperatures. For instance, a drum of Refrigerant at a temperature of 80°F (26.6°C) will have a pressure of 84.1 PSI (579.9 kPa). If it is heated to 125°F (51.6°C), the pressure will increase to 167.5 PSI (1154.9 kPa). It also can be used conversely to determine the temperature at which Refrigerant — 12 boils under various pressures. For example, at a pressure of 30.1 PSI (207.5 kPa), Refrigerant — 12 boils at 32°F (0°C).

(°F)(°C)		(PSIG)(kPa)		(°F)(°C)		(PSIG)(kPa)	
-21.7	29.8C	0(ATMOSPHERIC PRESSURE)	0(kPa)	55	12.7C	52.0	358.5
				60	15.5C	57.7	397.8
-20	-28.8C	2.4	16.5	65	18.3C	63.7	439.2
-10	-23.3C	4.5	31.0	70	21.1C	70.1	482.7
-5	-20.5C	6.8	46.9	75	23.8C	76.9	530.2
0	-17.7C	9.2	63.4	80	26.6C	84.1	579.9
5	-15.0C	11.8	81.4	85	29.4C	91.7	632.3
10	-12.2C	14.7	101.4	90	32.2C	99.6	686.7
15	-9.4C	17.7	122.0	95	35.0C	108.1	745.3
20	-6.6C	21.1	145.5	100	37.7C	116.9	806.0
25	-3.8C	24.6	169.6	105	40.5C	126.2	870.2
30	-1.1C	28.5	196.5	110	43.3C	136.0	937.7
32	0C	30.1	207.5	115	46.1C	146.5	1010.1
35	1.6C	32.6	224.8	120	48.8C	157.1	1083.2
40	4.4C	37.0	255.1	125	51.6C	167.5	1154.9
45	7.2C	41.7	287.5	130	54.4C	179.0	1234.2
50	10.0C	46.7	322.0	140	60.0C	204.5	1410.0

Fig. 1B-4--Pressure Temperature Relationships of R-12

kinks to prevent loss of system capacity due to line restriction.

- The flexible hose lines should never be bent to a radius of less than 4 times the diameter of the hose.
- The flexible hose lines should never be allowed to come within a distance of 63.5mm (2-1/2 in.) of the exhaust manifold.
- Flexible hose lines should be inspected regularly for leaks or brittleness and replaced with new lines if deterioration or leaking is found.
- When disconnecting any fitting in the refrigeration system, the system must first be discharged of all refrigerant-12. However, proceed very cautiously regardless of gage readings. Open very slowly, keeping face and hands away so that no injury can occur if there happens to be liquid Refrigerant-12 in the line. If pressure is noticed when fitting is loosened, allow it to bleed off as described under DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR C.C.O.T. A/C SYSTEMS.
- In the event any line is opened to atmosphere, it should be immediately capped or taped to prevent entrance of moisture and dirt, which can cause internal compressor wear or plugged lines, condenser and evaporator core, expansion tubes (orifice) or compressor inlet screens.
- The use of the proper wrenches when making connections on "O" ring fittings is important. The use of improper wrenches may damage the connection. The opposing fitting should always be backed up with a wrench to prevent distortion of connecting lines or components. When connecting the flexible hose connections it is important that the swaged fitting and the flare nut, as well as the coupling to which it is attached, be held at the same time using three different wrenches to prevent turning the fitting and damaging the ground seat.
- "O" rings and seats must be in perfect condition. A burr or piece of dirt may cause a refrigerant leak.

Always replace the "O" ring when a connection has been broken. When replacing the "O" ring, first dip it in clean 525 viscosity refrigeration oil.

- Where steel to aluminum connections are being made, use torque for aluminum tubing (Refer to Fig. 1B-6).

MAINTAINING CHEMICAL STABILITY IN THE REFRIGERATION SYSTEM

The efficient operation of the air conditioning refrigeration system is dependent upon the chemical stability of the refrigeration system.

When foreign materials, such as dirt, air or moisture contaminate the system, they will change the stability of Refrigerant-12. They will also affect pressure-temperature relationships, reduce efficient operation, possibly cause interior corrosion and abnormal wear of moving parts.

The following general practices should be observed to ensure chemical stability in the system:

1. Before disconnecting a refrigerant connection, wipe away any dirt or oil at and near the connection to reduce the possibility of dirt entering the system. Both sides of the connection should be capped, plugged or taped as soon as possible to prevent the entrance of dirt, foreign material and moisture.
2. Keep tools clean and dry. This includes the manifold Gage set and replacement parts.
3. When adding 525 viscosity refrigerant oil (Refer to ADDING OIL in the Discharging, Adding Oil, Evacuating and Charging Procedures for CCOT A/C Systems, the transfer device and container should be clean and dry to assure that refrigeration oil remains as moisture free as possible.
4. When it is necessary to "open" an A/C system, have everything needed ready and handy so that as little time as possible will be required to perform the operation. Do not leave the A/C system open any longer than is necessary.
5. Any time the A/C system has been "opened," it should be properly Evacuated before recharging with Refrigerant-12 according to the DISCHARGING ADDING OIL, EVACUATING & CHARGING PROCEDURES FOR CCOT A/C SYSTEMS.

All service parts are dehydrated and sealed prior to shipping. They should remain sealed until just prior to making connections. All parts should be at room temperature before uncapping (this prevents condensation of moisture from the air entering the system). If, for any reason, caps are removed, but the connections are not made, parts should be resealed as soon as possible.

DIAGNOSIS

TESTING THE REFRIGERANT SYSTEM

If a malfunction in the refrigerant system is suspected due to abnormal system pressures, check the following:

1. Check outer surfaces of radiator and condenser cores to be sure they are not plugged with dirt, leaves or other foreign material. Be sure to check between the condenser and radiator as well as the outer surfaces.
2. Restrictions or kinks in evaporator core or condenser core, hoses, tubes, etc.
3. Refrigerant leaks.
4. Check all air ducts for leaks or restrictions. Air restriction may indicate a plugged (or partially plugged) evaporator core.
5. Compressor clutch slippage.
6. Improper drive belt tension.
7. Plugged accumulator, expansion tube (orifice) or plugged suction inlet screen.
8. Excessive moisture in refrigerant system.

STEP	CONTROL SETTINGS			SYSTEM RESPONSE			
	MODE CONTROL	TEMPERATURE CONTROL	FAN SWITCH	BLOWER SPEED	HEATER OUTLETS	A/C OUTLETS	DEFROSTER OUTLETS
1	OFF	COLD	LO	OFF	NO AIR FLOW	NO AIR FLOW	NO AIR FLOW
2	MAX	COLD	LO	LOW	NO AIR FLOW	AIR FLOW	NO AIR FLOW
3	MAX	COLD	LO TO HI	LOW TO HIGH	NO AIR FLOW	AIR FLOW	NO AIR FLOW
4	NORM	COLD	HI	HIGH	NO AIR FLOW	AIR FLOW	NO AIR FLOW
5	BI/LEVEL	COLD	HI	HIGH	AIR FLOW	AIR FLOW	AIR FLOW
6	VENT	COLD	HI	HIGH	NO AIR FLOW	AIR FLOW	NO AIR FLOW
7	HEATER	HOT	HI	HIGH	AIR FLOW	NO AIR FLOW	MINIMUM AIR FLOW
8	DEF	HOT	HI	HIGH	MINIMUM AIR FLOW	NO AIR FLOW	AIR FLOW
Note: Small amount of air flow from the side window defogger outlet in all modes							

Fig. 1B-7--A/C Functional Test

LEAK TESTING THE REFRIGERANT SYSTEM

Whenever a refrigerant leak is suspected in the system or a service operation performed which results in disturbing lines or connections, it is advisable to test for leaks. **Liquid Leak Detectors.**

There are a number of locations (fittings, valves, etc.) on the air conditioning system where a liquid leak detector solution may be used to pinpoint refrigerant leaks.

By applying test solution to the area in question with the swab that is attached to the bottle cap, bubbles will form within seconds if there is a leak.

For restricted access areas, such as sections of the evaporator and condenser, an electronic leak detector, such as J-23400 or equivalent, is more practical for determining and locating leaks.

ELECTRONIC LEAK TESTERS

Electronic leak testers can accurately determine leaks in areas that are difficult to test with liquid leak detectors due to poor visibility or inaccessibility.

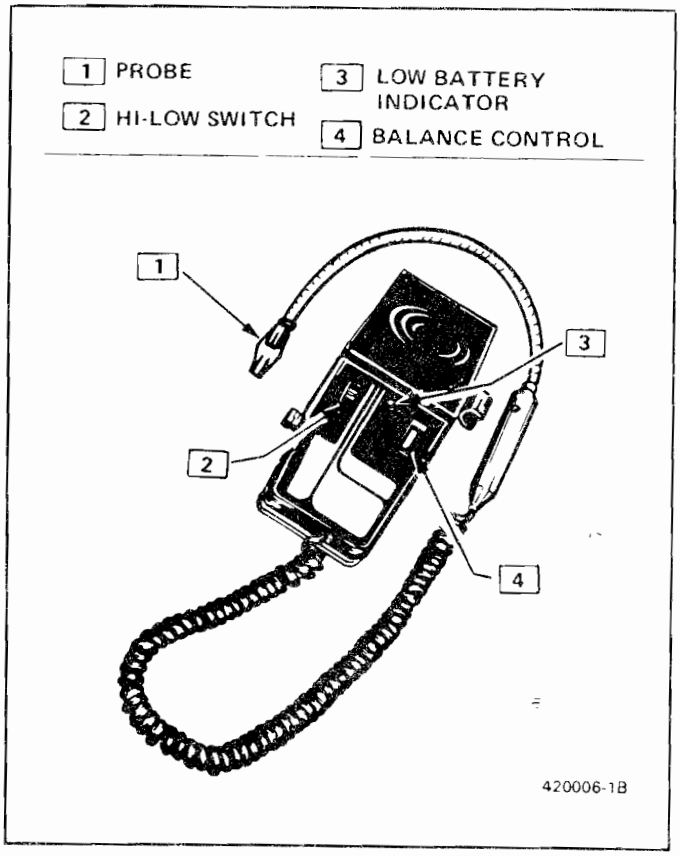
The H-10 Leak Detector J-26934 is a 110-volt, A/C powered tester while the Refrigerant Leak Detector J-29547 is a portable, battery operated model. Both models provide visual and/or audible signals to indicate leak detection.

The successful use of electronic leak detectors depends upon carefully following the manufacturers instructions regarding calibration, operation and maintenance. Battery condition is especially important to the accuracy of the portable battery powered model J-29547 and is monitored by a low battery indicator.

FUNCTIONAL TEST

To aid in determining whether or not the air conditioning electrical, air, vacuum and refrigeration systems are operating properly and efficiently, a chart of functional performance characteristics is shown in Fig. 1B-7.

1. Operation of the air conditioning blower at all speeds and engagement of the compressor clutch would indicate that electrical circuits are functioning properly.
2. The same hand-felt temperature of the evaporator inlet pipe AND the accumulator can surface of an operating system would indicate a properly charged R-12 system.
3. Operation of the control panel selector (mode) lever to distribute air from designed outlets would indicate proper vacuum and diaphragm function.



Electronic Leak Detector J-29547

CONDITION AND CAUSE	CORRECTION
Heater outlet Temperature too low.	Check duct work for proper installation. Check blower operation. Inspect TEMP lever and cable for proper operation. Check heater hoses for function. 1. Start engine and allow to warm up. 2. Set control panel for MAX mode. 3. Feel hose from water valve to heater core. Hose should not be hot. This indicates that vacuum is applied to the water control valve and that the water supply to the heater core is shut off. In any other position of the control panel selector (mode) lever, water should flow to the heater core. If not, check water control valve and vacuum supply hose.

Fig. 1B-8--Insufficient Heating

INSUFFICIENT COOLING "QUICK-CHECK" PROCEDURE

The following CCOT "Hand-Feel" procedure can be used to quickly determine whether or not the A/C system has the proper charge of Refrigerant-12 (providing ambient temperature is above 21°C (70°F) This check can be made in a matter of minutes, simplifying system diagnosis by pinpointing the problem to the amount of Refrigerant-12 charge in the system or by eliminating this possibility from the over-all checkout.

1. Engine must be warm (CHOKE OPEN and OFF FAST IDLE SPEED CAM) and at normal idle speed.
2. Hood and body doors open.
3. Selector (mode) lever set at NORM.
4. Temperature lever at COLD.
5. Blower on HI.
6. "Hand-Feel" temperature of evaporator inlet pipe after orifice and accumulator can surface with compressor engaged.
   a. BOTH SAME TEMPERATURE **AND** SOME DEGREE COOLER THAN AMBIENT--Proper condition: check for other problems.
   b. INLET PIPE COOLER than accumulator surface low refrigerant charge.
      - Add slight amounts 120 ml (1/4 lb.) of refrigerant UNTIL BOTH feel the same temperature. Allow stabilization time between additions.
      - Then add 420 ml (.88 lbs.) one can additional refrigerant. (The 420 ml/14 oz. disposable can of Refrigerant-12 is the equivalent to .88 lbs.)
   c. INLET PIPE HAS FROST ACCUMULATION-Accumulator surface warmer; proceed as in Step b above.

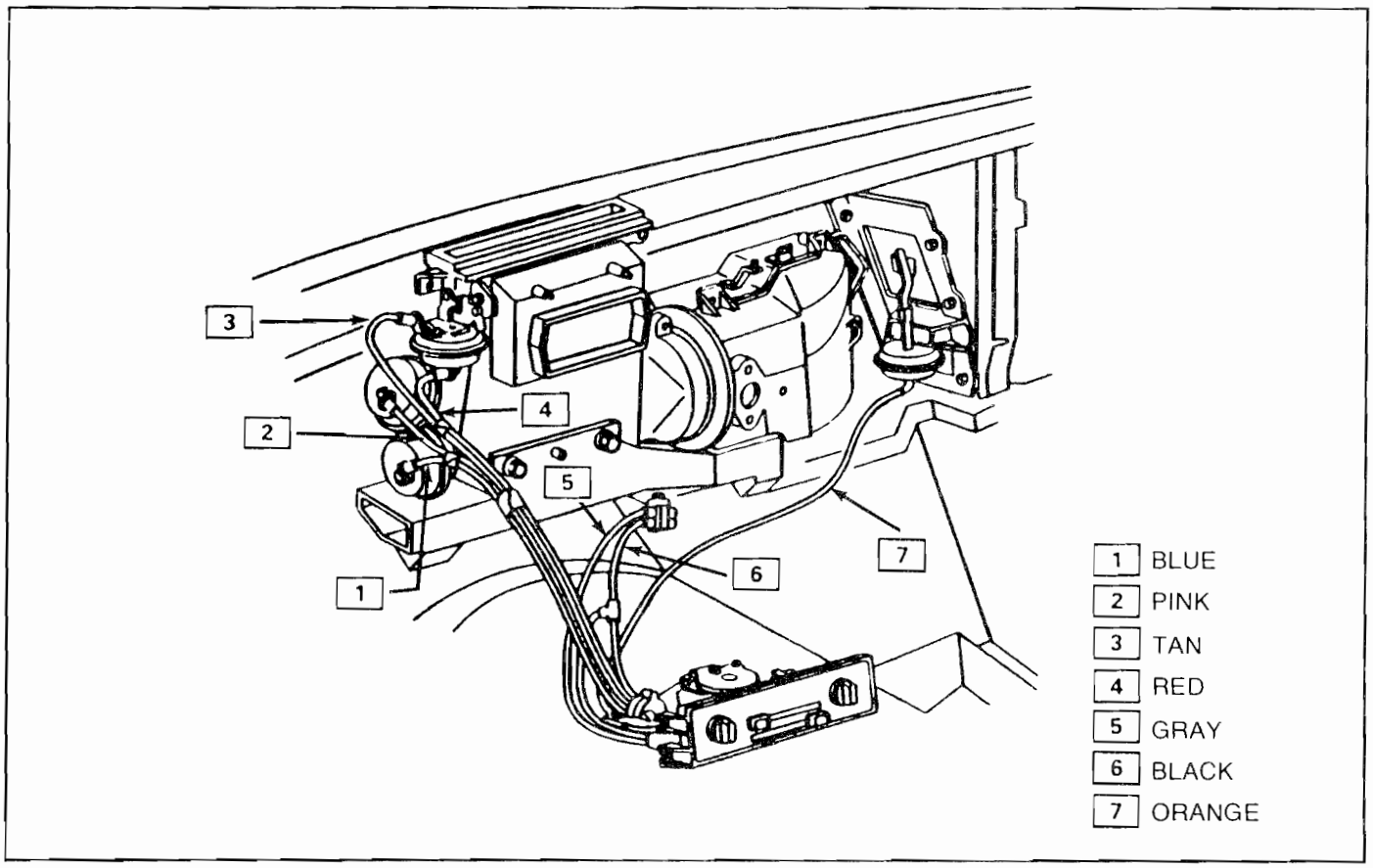


Fig. 1B-9--C60 Interior Vacuum Line Routing

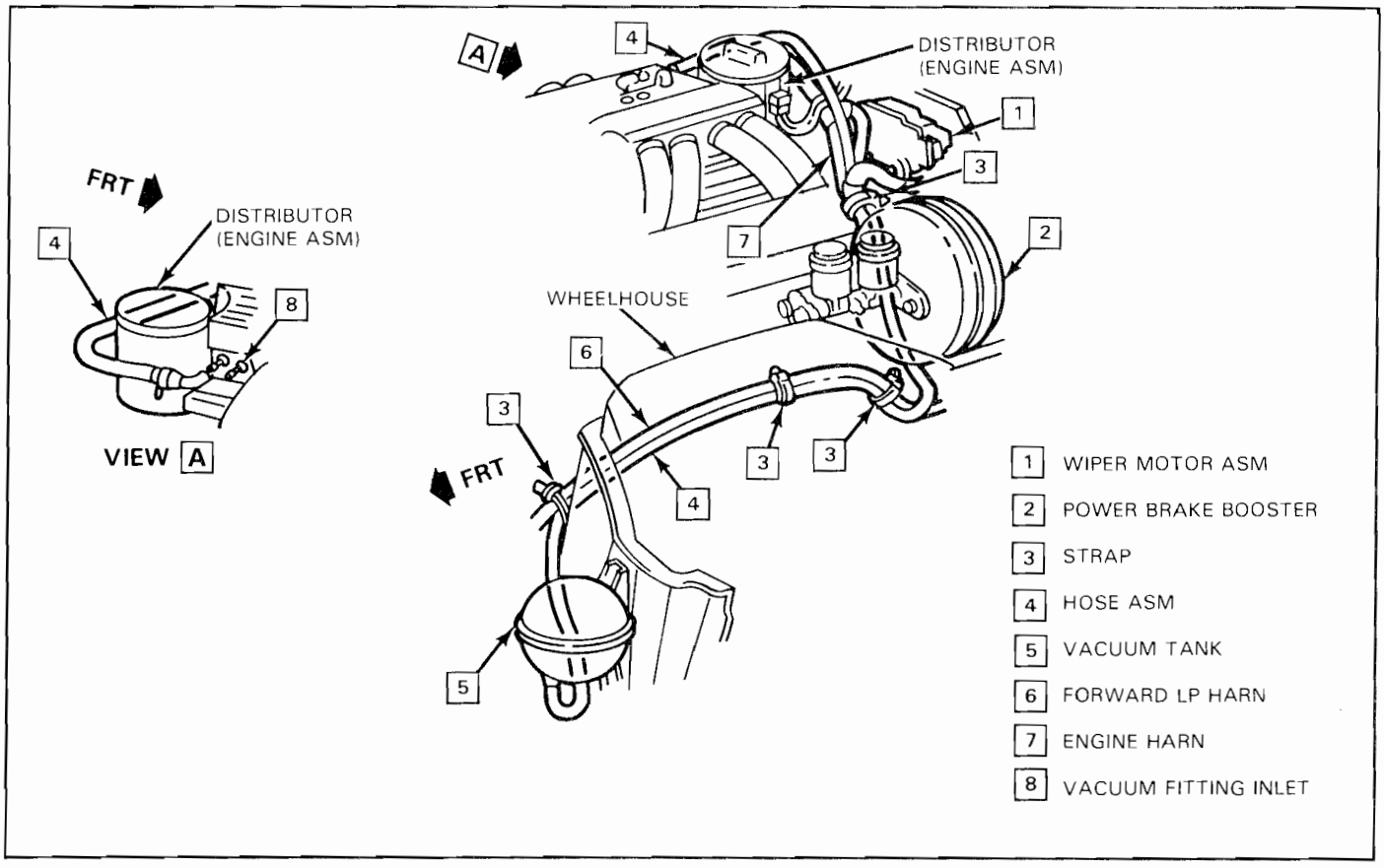


Fig. 1B-10--Vacuum Line Routing, Exterior

ON CAR SERVICE PROCEDURES

PRECAUTIONARY SERVICE MEASURES

Before any service is attempted which requires opening of refrigerant lines or components, the person doing the work should be thoroughly familiar with the information under PRECAUTIONS IN HANDLING Refrigerant-12, PRECAUTIONS IN HANDLING REFRIGERANT LINES AND FITTINGS MAINTAINING CHEMICAL STABILITY IN THE REFRIGERATION SYSTEM, AND REFRIGERANT CHARGING PRECAUTIONS and should follow very carefully the DISCHARGING, EVACUATING, OIL ADDITION AND CHARGING THE REFRIGERANT SYSTEM instructions given on the following pages for the unit being serviced.

Sealing caps should be removed from subassemblies just prior to making connections for final assembly. Use a small amount of clean 525 viscosity refrigerant oil on all tube and hose joints. Always use new "O" rings dipped in the clean 525 viscosity refrigerant oil when assembling joints. The oil will aid in assembly and help provide a leak-proof joint. When tightening joints, use a second wrench to hold stationary part of connection so that a solid feel can be attained. This will indicate proper assembly.

Tighten all tubing connections, as shown in torque Chart 1B-6. Insufficient or excessive torque when tightening can result in loose joints or deformed joint parts. Either condition can result in refrigerant leakage.

DISCHARGING EVACUATING ADDING OIL AND CHARGING PROCEDURES FOR CCOT A/C SYSTEMS

The refrigerant system may be Discharged, Evacuated and Charged using J-23500-01 air conditioning service Charging Station or the J-5725-04 Manifold and Gage Set, and 420 ml-14 oz. disposable cans of Refrigerant-12.

Charging lines from the Charging Station or Manifold and Gage Set require the use of gage adapters to connect to the system service fittings. A straight gage Adapter J-5420 and a 90° angle gage Adapter J-9459 are available.

Always wear goggles and wrap a clean cloth around fittings and connections when doing work that involves opening the refrigeration system. If liquid refrigerant comes into contact with the skin or eyes injury can result.

- Before removing and replacing any of the air conditioning refrigeration lines or components, the system must be completely discharged of Regrigerant-12.
- Always use service valve and pressure gage sets during evacuation and charging procedures.
- Do not charge while compressor system is hot.
- Always discharge system at low-side service fitting and perform the entire evacuate and charging procedure through the low-side service fitting.
- Do not connect high pressure line or any line to the high-side service fitting during discharging and charging procedures.

CAUTION: Never remove a gage line from its adapter when line is connected to A/C system. Always remove the line adapter from the service fitting to disconnect a line. Do not remove charging hose at gage set while attached to service low-side fitting. This will result in complete discharge of system due to the depressed schrader valve in service low-side fitting and may cuase personal injury due to escaping Refrigerant-12.

Discharging the CCOT A/C System

In replacing any of the air conditioning refrigeration components the system must be completely discharged of Refrigerant-12.

Always discharge system at low side service fitting.

1. With ignition turned OFF, remove protective cap from LOW-SIDE service fitting and connect Charging Station J-23500-01 Gage Set as indicated in Figure 1B-11.

   If charging station J-23500-01 is not being used, discharge system by slowly connecting a gage hose to low-side service fitting on Accumulator and discharging into oil bottle (Fig. 1B-12). As hose is SLOWLY tightened down onto schrader valve, Refrigerant-12 will be in to discharge from the system into the container. If no discharge occurs, check for missing or defective schrader depressor in hose fitting.
2. With the low-side of system fully discharged, check high-side system fitting (on liquid line or muffler) for remaining pressure.
3. If pressure is found, attempt to discharge high-side using same procedure as used for low-side. (This condition indicates a restriction on the high-side and the cause must be diagnosed and corrected before evacuating and charging the system).
4. When the system is completely discharged (no vapor escaping with hose fully-tightened down), measure, record amount and discard the collected refrigerant oil. If this quantity is 15 ml (1/2 oz.) or more, this amount of new 525 viscosity refrigerant oil must be added to system, plus any quantity in removed parts before evacuation and charging with Refrigerant-12 (Refer to CCOT Refrigerant Oil Distribution for specific quantity of oil normally retained in removed parts).
5. If adding oil is necessary, remove the suction hose at the accumulator outlet pipe connection and pour the correct quantity of refrigerant oil into the hose or pipe and then properly reconnect hose or pipe. (See Discharging Step No. 4 and C.C.O.T. Refrigerant Oil Distribution for specific quantity instructions).

CCOT Refrigerant Oil Distribution

R-4 COMPRESSOR -- requires 6 oz. (180 ml) of 525 viscosity refrigerant oil.

New oil quantities must be added to the system during Service component replacement and conditions stated as follows:

A. WHEN THERE ARE NO SIGNS of excessive oil leakage, for:
   - Compressor - Remove, drain oil, measure, replace same amount of new oil.
   - Evaporator - Add 90 ml (3 oz.).
   - Condenser - Add 30 ml (1 oz.).

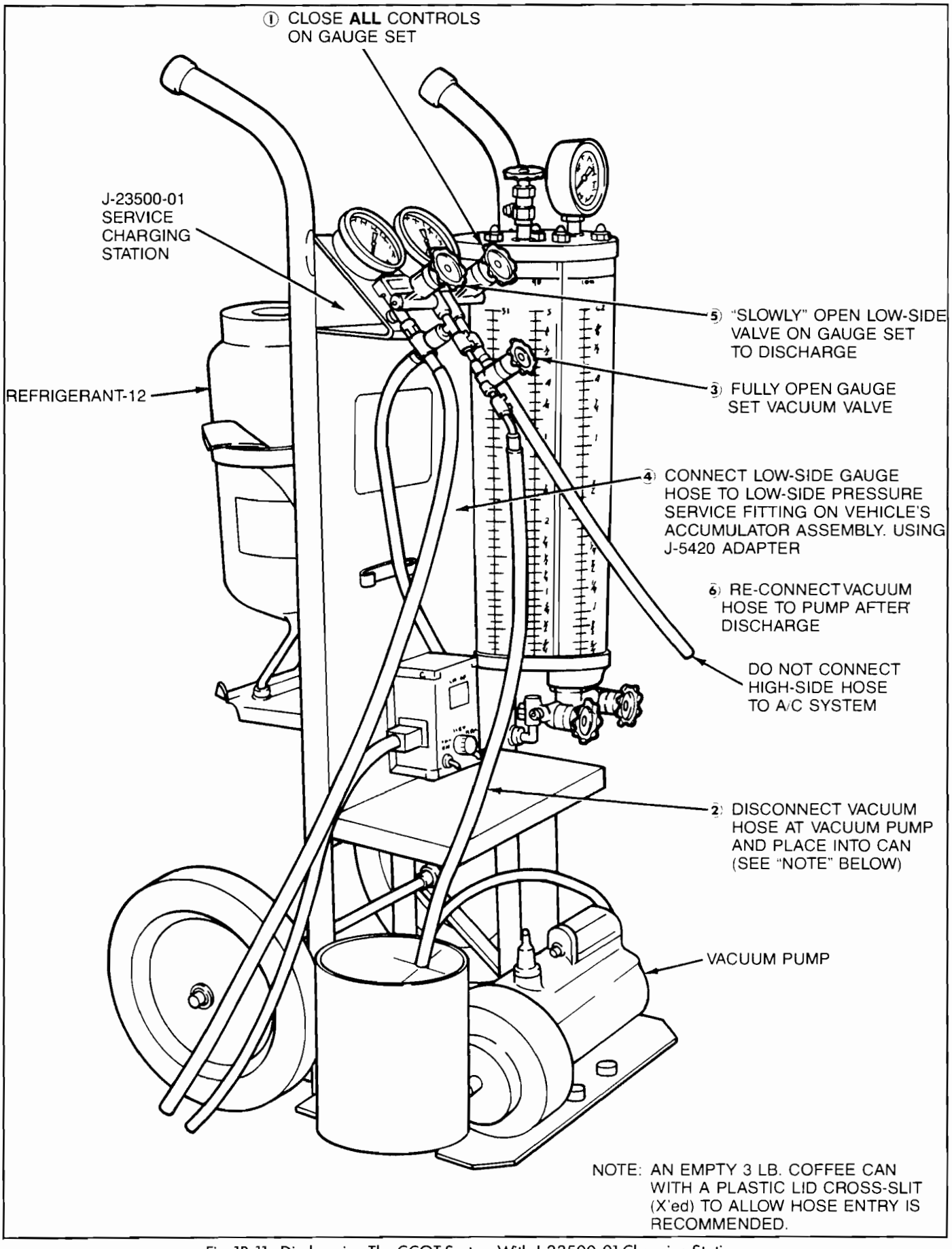


Fig. 1B-11--Discharging The CCOT System With J-23500-01 Charging Station

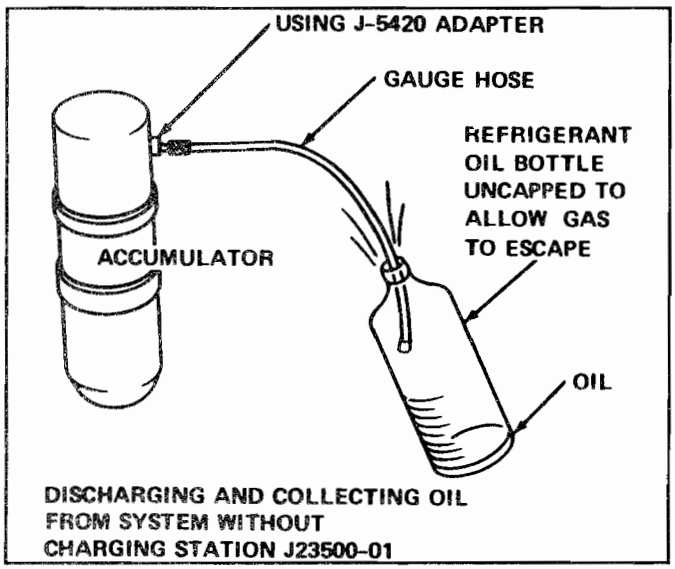


Fig. 1B-12--Discharging the CCOT A/C System Without Charging Station J-23500-01

- Accumulator - R-4 Compressor - Remove, drain oil, measure, replace same amount of new oil plus 60 ml (2 oz.) to compensate for that retained by the original accumulator dessicant.

B. WITH SIGNS OF EXCESSIVE OIL LEAKAGE, for:

R-4 Compressor Systems

A. With no signs of excessive oil leakage, add:

- Compressor - Remove, drain oil, measure, replace same amount of new oil.
- Evaporator - Add 90ml (3 fl. oz).
- Condenser - Add 30 ml (1 fl. oz).
- Accumulator - Remove, drain oil, measure, replace same amount of new oil plus 60ml (2 fl. oz) to compensate for that retained by the original accumulator dessicant.

EVACUATING AND CHARGING THE CCOT A/C SYSTEM

If the system has been opened for any repair, or the Refrigerant-12 charge lost, the system must be evacuated prior to charging.

Evacuation and Charging is a combined procedure, and all gage lines must be purged with Refrigerant-12 prior to charging.

There are three standard Refrigerant-12 evacuate and charge procedures:

- J-23500-01 Charging Station Method
- Disposable Can Method
- Drum Method

NOTICE: Under no circumstances should alcohol be used in the system in an attempt to remove moisture. Damage to the system components could occur.

Gage Calibration

Prior to Evacuation, check the low pressure gage for proper calibration and determine if vacuum system is operating properly. With the gage disconnected from the refrigeration system, be sure that the pointer indicates to the center of "O". Lightly tap gage a few times to be sure pointer is not sticking. If necessary, calibrate as follows:

a. Remove cover from gage.

b. Holding gage pointer adjusting screw firmly with one hand, carefully force pointer in the proper direction to position pointer at the "O" position. Tap gage a few times to be sure pointer is not sticking. Replace gage cover.

Vacuum System Check

Before connecting vacuum pump to the A/C system, run pump connected to the low pressure gage to determine the vacuum pump capability. If the vacuum system is unable to reach 711.2-736.6mm (28"-29") or more vacuum, the system should be checked for leaks. If no leaks are found, the vacuum pump may require repair.

J-23500-01 Charging Station Method

Follow Charging instructions provided with the J-23500-01 Charging Station in use with the following exceptions:

1. Do not connect the high pressure line to the air conditioning system.
2. Keep the high pressure valve on the charging station closed at all times.
3. Perform the entire evacuate and charge procedure through the accumulator low-side pressure service fitting.
4. Following these procedures will prevent accidental high-side vehicles system pressure being subjected to the Charging Station in the event an error is made in valve sequence during compressor operation to pull in the Refrigerant-12 charge.

Disposable Can Or Refrigerant Drum Method

- If the Refrigerant-12 drum is used, place it on a scale and note the total weight before Charging. Watch the scale during Charging to determine the amount of Refrigerant-12 used.
- If disposable 420 ml (14 oz.) Refrigerant-12 cans are used, close the tapping valve and then attach can(s) following instructions included with the tapping valve or tapping manifold adapter.

1. Connect Manifold Gage Set J-5725-04 as follows. Also see Fig. 1B-13.
   - Low pressure gage set valve to Accumulator fitting
   - Gage set center hose to Refrigerant-12 source

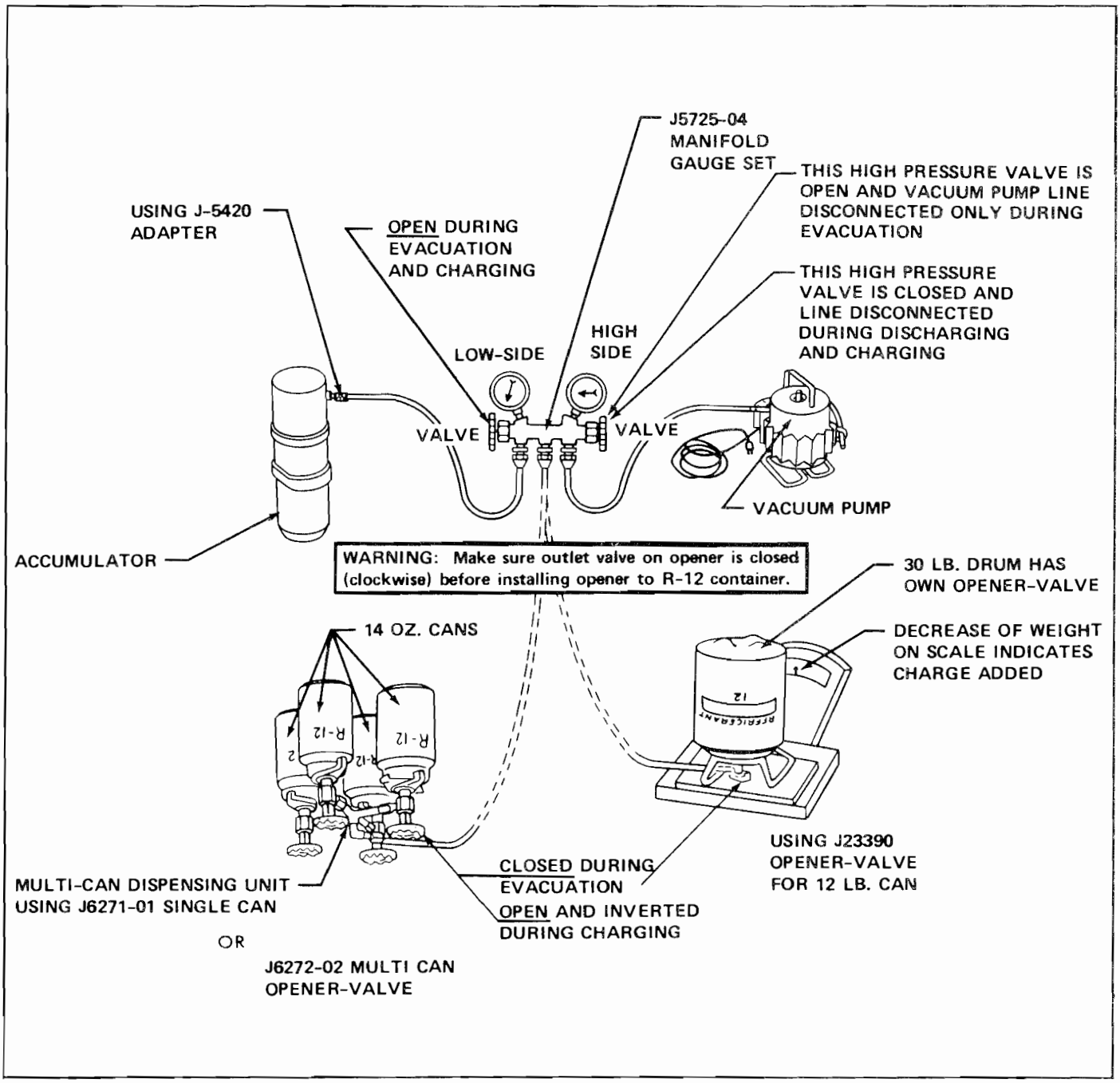


Fig. 1B-13--Charging the CCOT A/C System with Disposable Can or Refrigerant Drum

- High pressure gage to vacuum pump

2. To begin evacuation of the A/C system, with Manifold Gage Set and Vacuum Pump, SLOWLY open high and low-side gage valves and begin vacuum pump operation. Pump the system until the low-side gage reaches 711.2 - 736.6mm (28 to 29 in.) mercury (vacuum) or more.

   Note that in all Evacuation procedures, the specification of 711.2 - 736.6mm (28 to 29 in.) of mercury vacuum is used. This specification can only be reached at or near sea level. For each 304.8m (1,000 feet) above sea level, specification should be lowered by one inch of vacuum. At 1524m (5,000) feet elevation only 584.2 - 609.6mm (23 to 24 in.) of mercury (vacuum) is required.

   If prescribed mercury (vacuum) cannot be reached, close vacuum control valve, shut off pump and look for a leak at connections or pump.

3. When the gage reaches prescribed vacuum, the system is fully evacuated. Close the high-side gage set valve and turn OFF the vacuum pump.
4. Watch low-side gage to be sure vacuum holds for five (5) minutes. If vacuum is held, disconnect vacuum hose at gage set and then proceed to charging.
5. If vacuum does not hold for five (5) minutes, charge system with 420 ml (1/2 lb.) Refrigerant-12 and leak check. Discharge system again then repair leak as necessary. Repeat Evacuation procedure.

Charging of the CCOT A/C System

1. Start engine, run with choke open and fast idle speed reduced to normal idle, set A/C control lever on OFF.
2. With the Refrigerant-12 drum or 420 ml (14 oz.) can(s) inverted, open Refrigerant-12 source valve(s) and allow 480 ml (one (1) pound) or one 420 ml (14 oz.) can of liquid Refrigerant-12 to flow into system through low-side Service fitting on Accumulator (Refer to Fig. 1B-13).
3. As soon as 480 ml (1 lb.) or one 420 ml (14 oz.) can of liquid Refrigerant-12 has been added to system, immediately engage the compressor, by setting the A/C control lever to NORM and blower speed on HI, to draw in the remainder of the Refrigerant-12 charge. (Total Refrigerant 12 charge is 2.75 lbs.)

   The Charging operation can be speeded up by using a large volume fan to pass air over the condenser. If condenser temperature is maintained below charging cylinder temperature, Refrigerant-12 will enter system more rapidly.
4. Shut off Refrigerant-12 source valve and run engine for 30 seconds to clear lines and gages.
5. With the engine running, remove the charging low-side hose adapter from the Accumulator Service fitting. Unscrew rapidly to avoid excess Refrigerant-12 escape from system.

   CAUTION: Never remove a gage line from its adapter when line is connected to A/C system. Always remove the line adapter from the service fitting to disconnect a line. Do not remove charging hose at gage set while attached to accumulator. This will result in complete discharge of system due to the depressed schrader valve in service low-side fitting, and may cause personal injury due to escaping Refrigerant-12.

6. Replace protective cap on Accumulator fitting.
7. Turn engine off.
8. Leak check system with J-6084 Leak Detector.
9. Start engine.
8. With system fully Charged and leak-checked, continue to operate system and test for proper system pressures.

COMPONENT REPLACEMENT

ACCUMULATOR ASSEMBLY

The accumulator assembly for the CCOT system has a service replacement which includes two "O" rings (for the inlet and outlet connections). The desicant within the shell is **NOT** serviced separately - it is part of the sealed accumulator assembly. See CCOT Refrigerant Oil and Distribution for presence of refrigerant oil and service conditions when the accumulator must be removed from the vehicle to measure the amount of oil present inside the accumulator.

The accumulator assembly should ONLY be replaced when:

1. A physical perforation to the accumulator is found resulting in a leak.
2. The expansion (orifice) tube screen experiences continued or repeated plugging.
3. The compressor inlet screen is plugged.
4. An evaporator fails because of inside-out (internal corrosion.

DO NOT REPLACE the accumulator assembly where:

1. Merely a dent is found in the outer shell of the accumulator.
2. A vehicle is involved in a collision and no physical perforation to the accumulator is found. An open refrigerant line should be capped or have a plastic bag tightly taped around it.

Removal and Installation

1. Disconnect battery ground cable.
2. Discharge system of refrigerant.
3. Disconnect accumulator inlet and outlet connections. Cap or plug open lines immediately.
4. Remove accumulator attaching screws and check amount of oil in accumulator and install this amount of fresh 525 viscosity refrigerant oil into new accumulator plus 60 ml (2 oz.)
5. Install new accumulator, using clean 525 viscosity refrigerant oil on "O" rings.
6. Evacuate and recharge system.

EXPANSION TUBE (ORIFICE)

Removal and Installation

1. Discharge the refrigerant from the system.
2. Disconnect liquid line at evaporator inlet and remove expansion tube (orifice) from the inlet pipe.
3. To install, reverse the above procedure. When installing the expansion tube (orifice) inside the evaporatior inlet pipe, it MUST be installed with "shorter screen end" inserted first.

TEMPERATURE CABLE

Replacement

1. Open the hood and disconnect the battery ground cable.
2. Remove the cluster bezel and tilt lever. See Instrument Panel and Gages Section.
3. Remove the center bezel above the console.
4. Remove the control head to carrier attaching screws and rotate to gain access.
5. Disconnect the electrical and vacuum connections.
6. Disconnect the temperature cable.
7. Remove the right side hush panel.
8. Disconnect the cable at the heater case.
9. Remove the cable assembly using wire to pull new cable into place.

To reinstall, reverse the above procedure and make the proper adjustment. Check for correct operation.

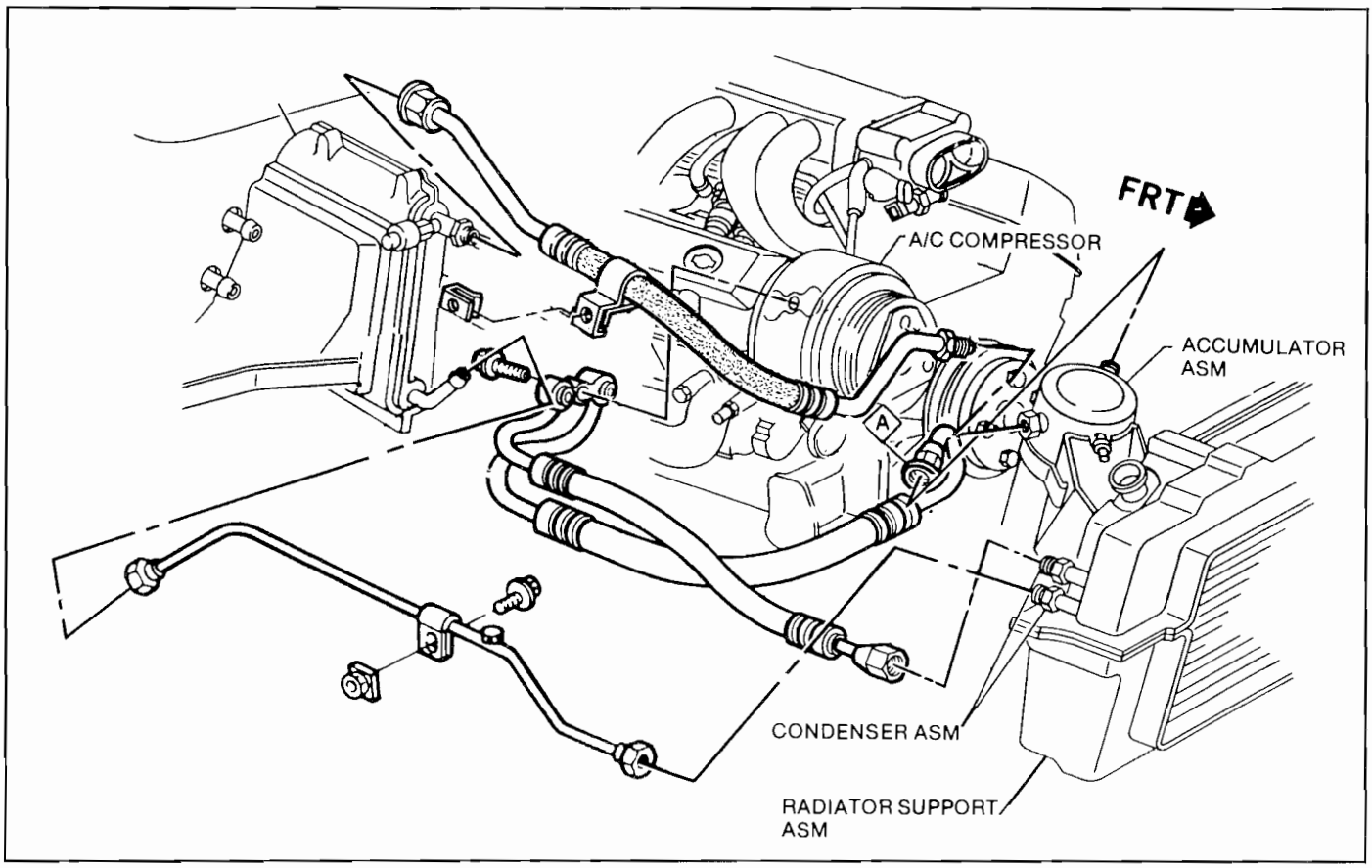


Fig. 1B-14--Refrigerant Hose Routing

Adjustment

Rotate adjustment knob until the cable lever reads full hot and cold.

BLOWER MOTOR

Replacement

1. Open the hood and disconnect the battery ground cable.
2. Remove the front wheel house rear panel and move wheel house seal aside.
3. Remove the motor cooling tube.
4. Remove the relay.
5. Remove the blower motor assembly to case attaching screws.
6. Remove the motor and impeller.

To install, reverse the replacement procedure and check the operation.

EVAPORATOR CORE

Remove

1. Open hood and disconnect the battery negative cable.
2. Discharge the A/C system as shown in this section.
3. Remove the air cleaner.
4. Remove the front wheel house rear panel and seal.
5. Disconnect the electrical connections, windshield washer hose and hood release cable at the housing and lay aside.
6. Disconnect the evaporator outlet hose at the evaporator and remove hose bracket at inner fender.
7. Remove pressure cycling switch.
8. Release pressure on cooling system, cut heater hoses at heater core inlet and outlet, and remove hot water valve.(Heater hoses will have to be replaced on installation.)
9. Remove heater hose bracket at inner fender.
10. Disconnect evaporator inlet hose at evaporator and remove hose bracket at inner fender.
11. Remove transmission cooler line rear bracket at frame.
12. Remove left half cover to bulkhead bolts and nuts.
13. Remove left half to right half cover bolts and evaporator inlet bracket screw.
14. Split the two halves and remove the evaporator core.

Install

1. Clean cover mating surfaces.
2. Install cover with new evaporator on bulkhead studs.
3. Seal cover.

To complete installation, reverse the removal procedure, evacuate and recharge A/C system, fill cooling system and check for proper operation.

HEATER CORE (Fig. 1B-19)

Replacement

1. Open hood and disconnect the battery negative cable.

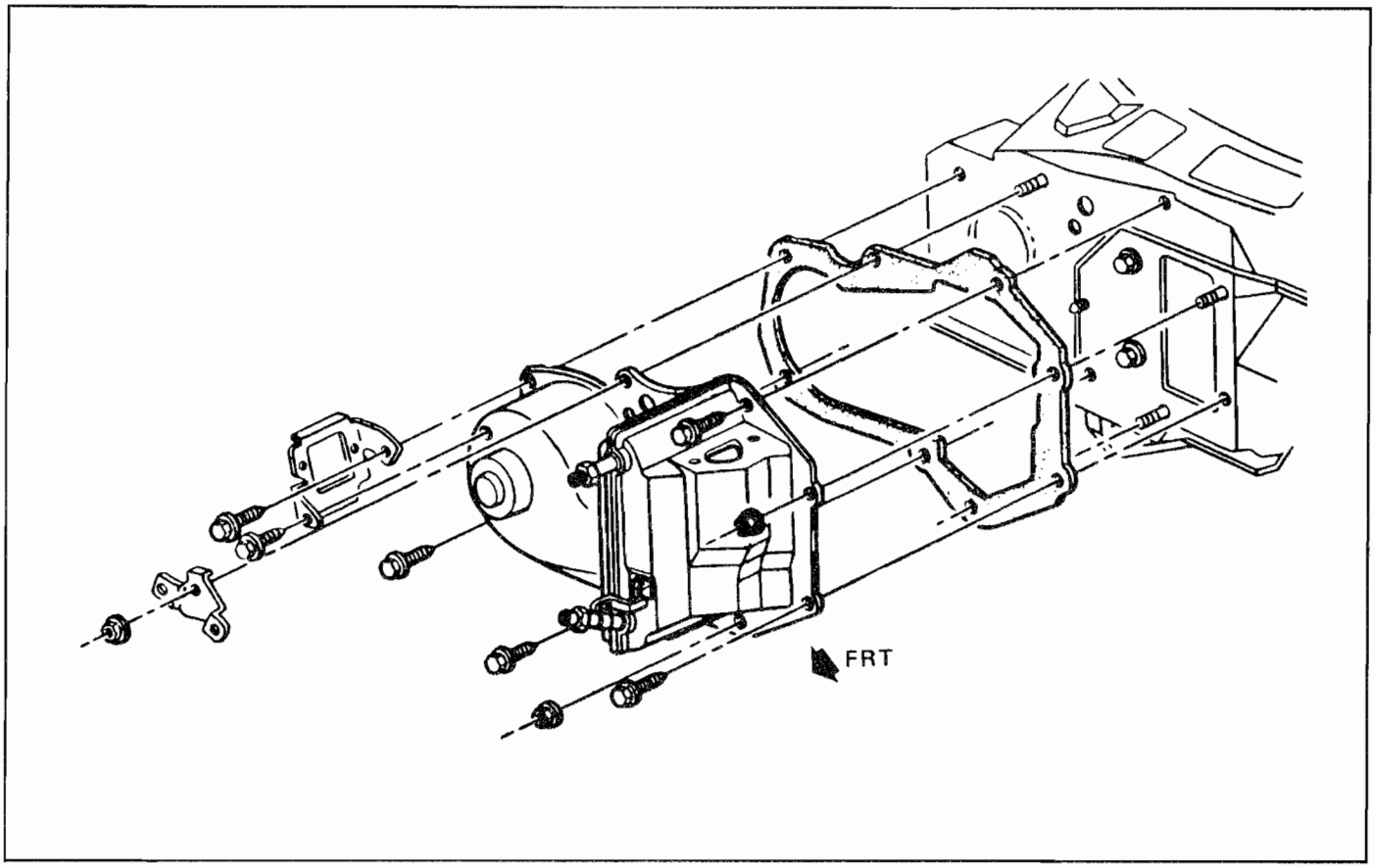


Fig. 1B-15--Blower Motor and Evaporator Module

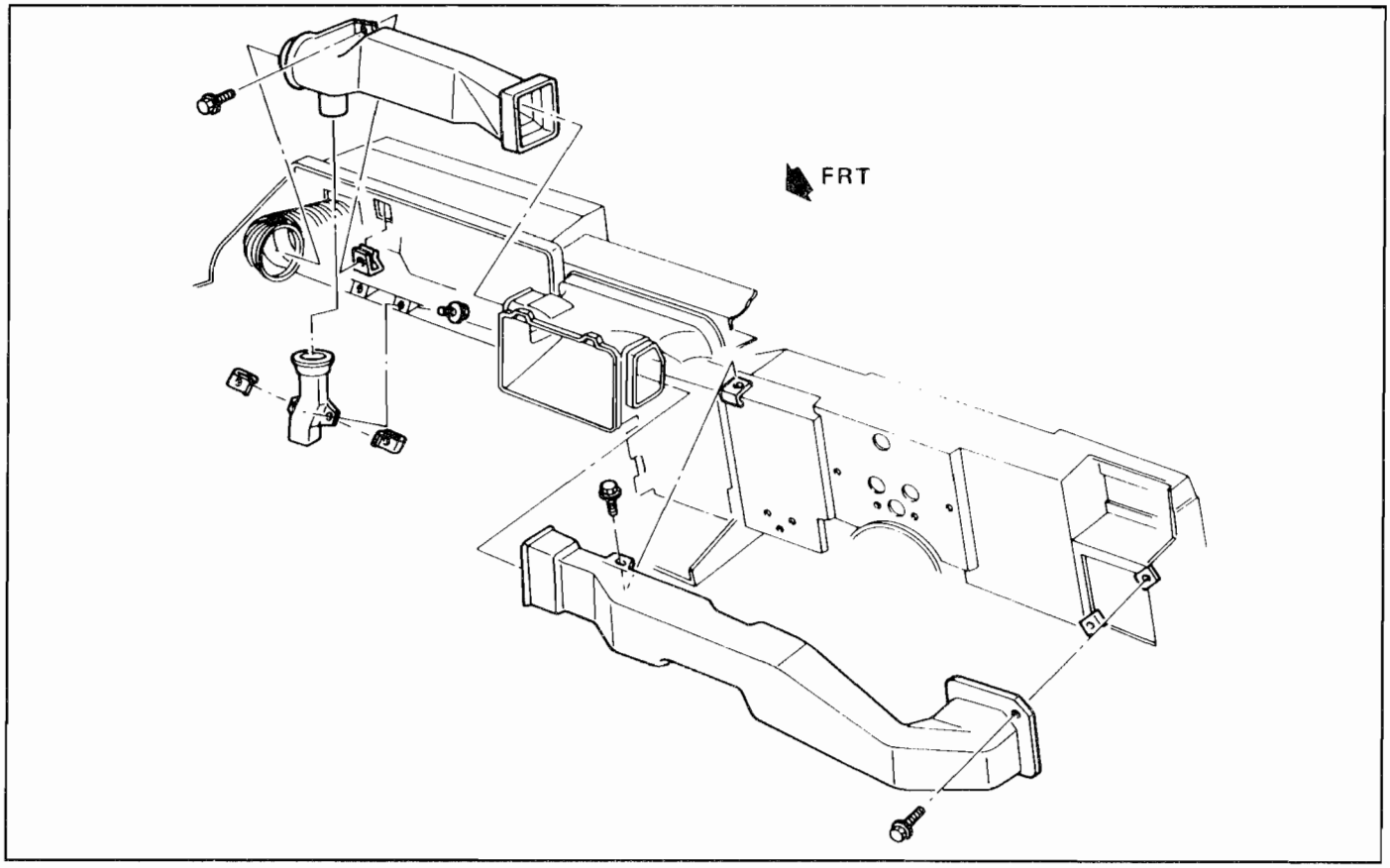


Fig. 1B-16--Duct Assembly

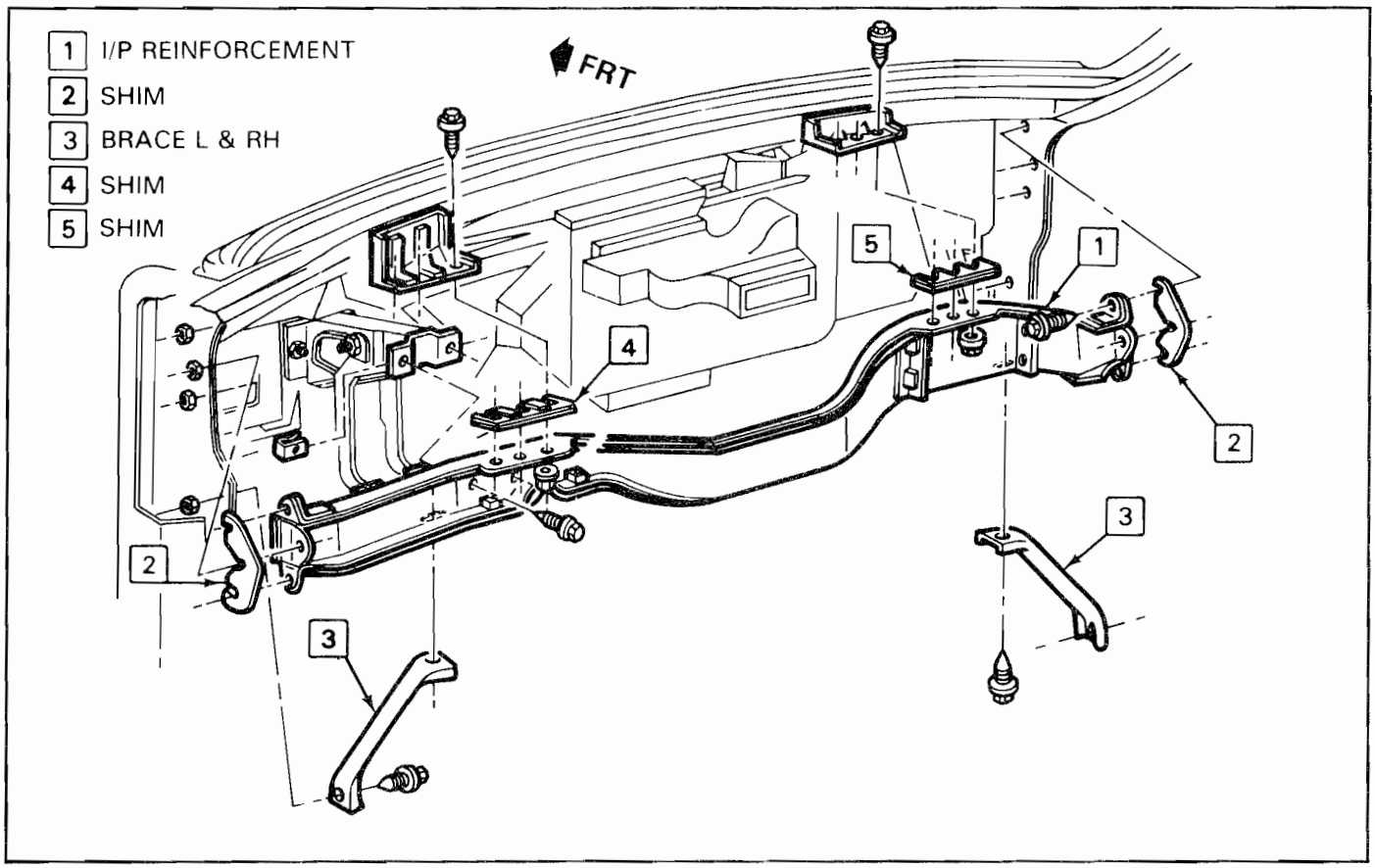


Fig. 1B-17--I.P. Reinforcement Brace

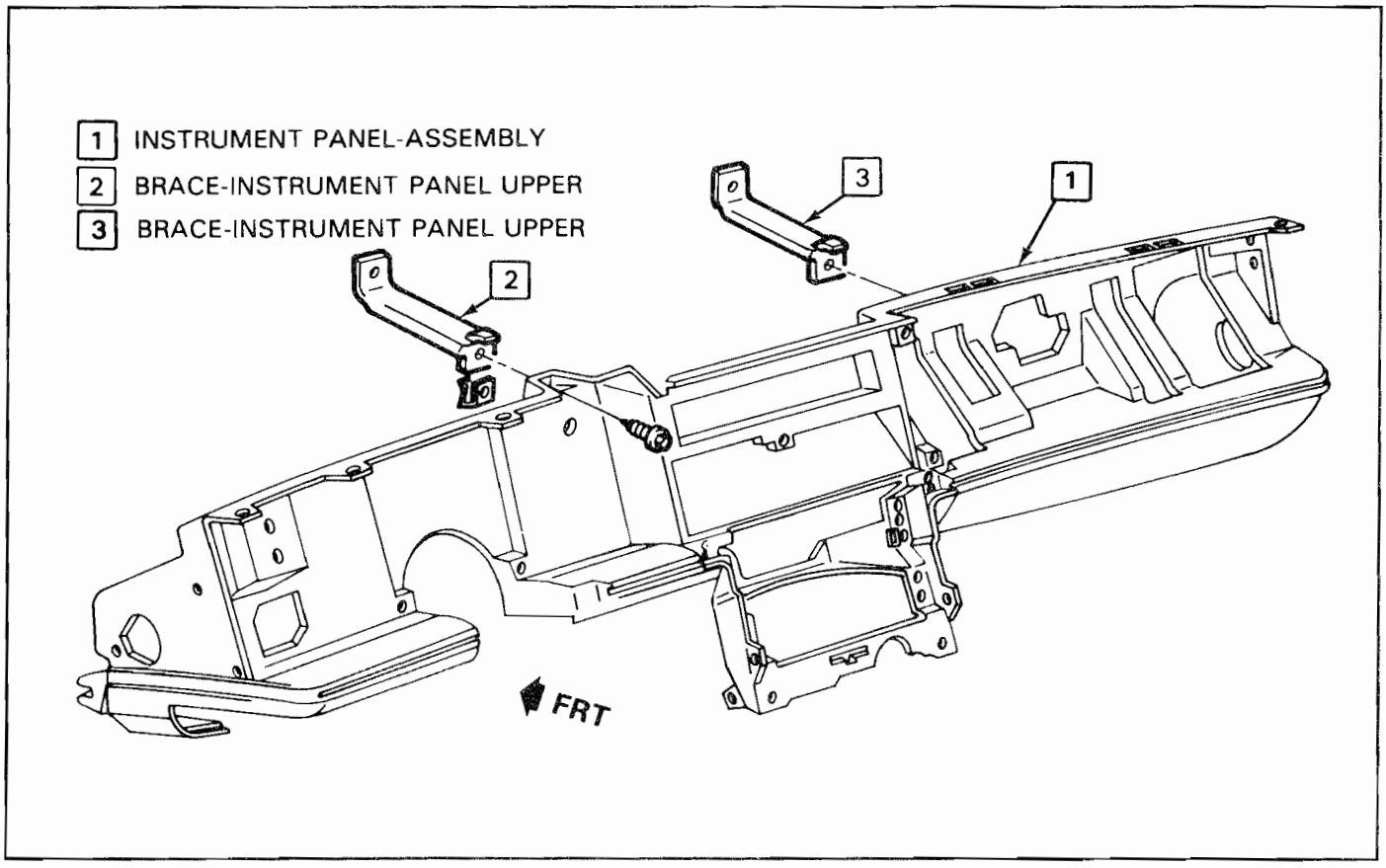


Fig. 1B-18--I.P. Brackets

2. Remove the instrument cluster bezel including the tilt wheel lever and I.P. pad. See Instrument Panel and Gage Section.
3. Remove the A/C distributor duct and disconnect the flex hose.
4. Remove the right side hush panel.
5. Remove the side window defroster flex hose.
6. Remove the side window defroster to heater cover screws and disconnect the extension.
7. Remove the temperature control cable and bracket assembly at heater cover including disconnecting heater door control shaft.
8. Remove the ECM (Electronic Control Module) and disconnect the electrical connectors.
9. Remove the tubular support brace from the door pillar to aluminum, instrument panel reinforcement brace.
10. Remove heater core cover attaching screws.
11. Remove heater pipe and heater water control bracket attaching screws.
12. Cut heater hose at heater core pipes, measure, cut and replace when reinstalling.
13. Remove the heater core.

To install, reverse the replacement procedure. Fill the cooling system and check for correct operation.

CONDENSER

Replacement

1. Open the hood and disconnect the battery negative cable.
2. Discharge the system as shown in this section.
3. Remove the radiator cap.
4. Remove the accumulator hold-down clamp and set accumulator to one side.
5. Remove the accumulator at the frame.
6. Remove the fan to upper shroud attaching screws.
7. Remove the upper shroud attaching screws and move the shroud rearward.
8. Disconnect the condenser inlet and outlet fittings and install new "O" rings.
9. Remove the condenser from its carrier.
10. Add oil to the new condenser, install by reversing the removal procedure, evacuate the system, charge and check operation.

RECIRCULATION VALVE, VACUUM ACTUATOR

A vacuum tank and check valve are used to assure that the air door will not change its position due to variations in engine vacuum.

Replacement

1. Remove the right side hush panel.
2. Remove the tubular brace from the door pillar to the aluminum cross car instrument panel reinforcement assembly.
3. Remove the actuator.

To install, reverse the removal procedure and adjust the door arm. When adjustment is complete, check the operation.

Air Selector and Ducts

Air Selector and Ducts assembly are shown in Fig. 1B-12 and 1B-19.

See Heater core replacement.

CONTROL HEAD (FIG. 1B-21)

Replacement

1. Open hood and disconnect the battery ground cable.
2. Remove the cluster bezel, including tilt wheel lever. See Instrument Panel and Gages Section.
3. Remove the center bezel above the console. See Instrument Panel and Gages Section.
4. Remove the screws attaching the control assembly to its carrier.
5. Rotate the control assembly to gain access to the electrical connectors, temperature control cable and vacuum hoses.

To reinstall the control head, reverse the replacement procedure and check the operation.

EXPANSION TUBE

The expansion tube is located in the evaporator core inlet line.

Replacement

1. Discharge system.
2. Remove the right front wheel housing rear section for access.
3. Disconnect the condenser to evaporator line at the evaporator inlet. Cap the open line at once.
4. Using needle-nose pliers, remove the expansion tube from the evaporator core inlet line.
5. Remove the expansion tube "O" ring from the core inlet line.
6. To install, reverse Steps 1-4 above.

   Install the expansion tube using a new "O" ring coated with clean refrigeration oil, by inserting the short screen end of the tube into the evaporator inlet line.
7. Evacuate, charge and check the system.

Pressure Cycling Switch

Compressor clutch cycling is accomplished through the use of a pressure sensing switch on the accumulator.

The switch performs two functions in the system. In addition to cycling the compressor on and off to control refrigerant flow, the switch shuts off the compressor clutch when pressure falls to a predetermined level, indicating low refrigerant charge in the system.

When diagnosis indicates replacement of the switch is necessary, it should be noted that it will not normally be necessary to discharge the A/C system, as the pressure switch fitting on the accumulator is equipped with a schrader type valve.

When replacing the pressure cycling switch, a new oiled "O" ring must be installed and the switch must be torqued to 10 N·m (7.5 ft. lb.).Do not exceed this torque as the threads in the evaporator outlet may be stripped.

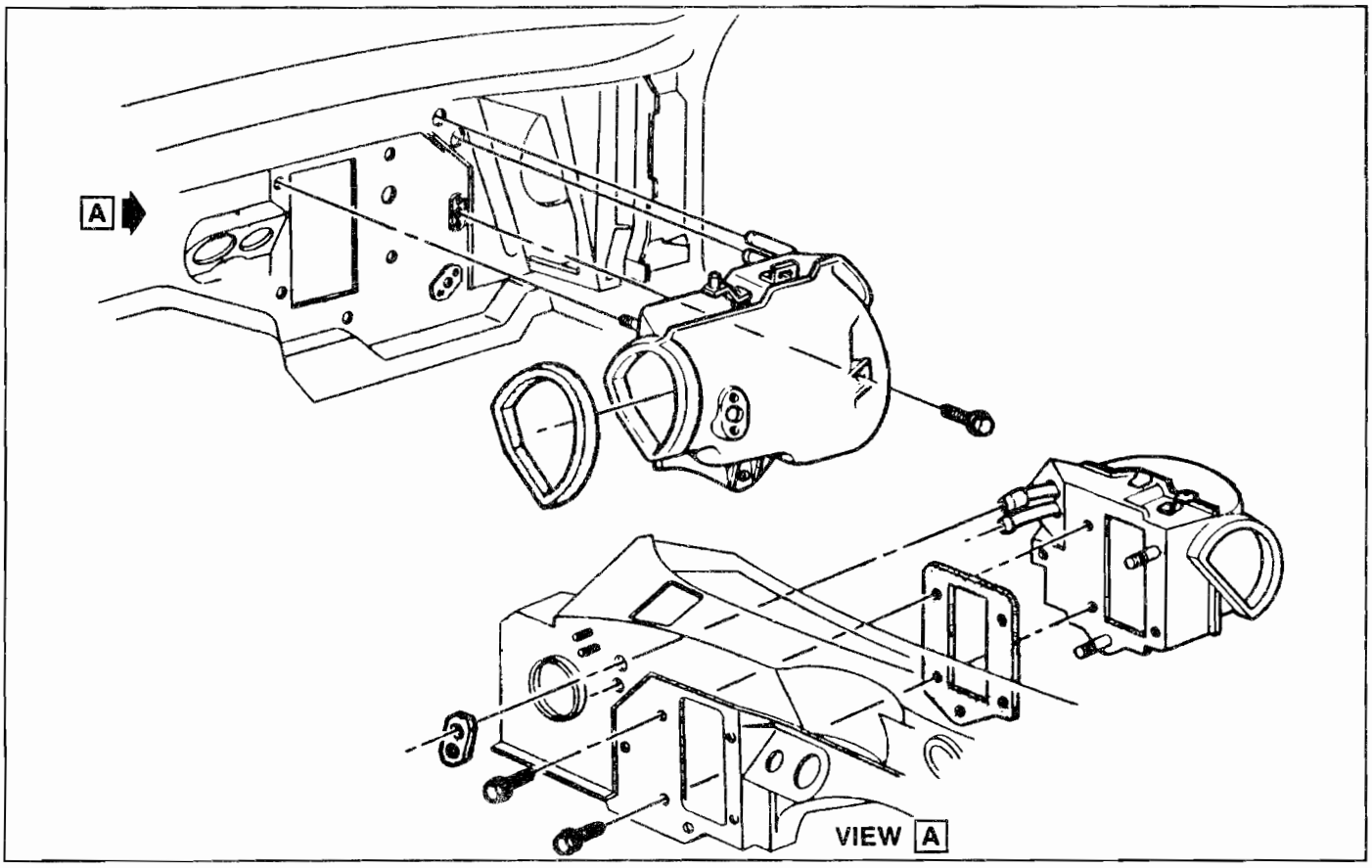


Fig. 1B-19--Heater Core Case

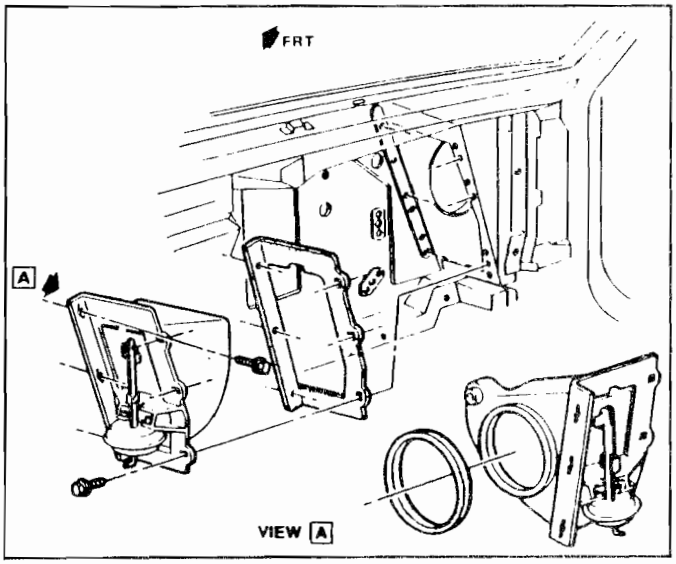


Fig. 1B-20--Air Inlet Valves

FUSES

A fuse, located in the junction block, protects the entire air conditioning system except the blower when operating at high speed.

A second fuse, to protect the high speed blower circuit, is located in the electrical wiring between the junction terminal and the Air Conditioner relay.

ACCUMULATOR

Replacment

1. Disconnect battery ground cable.
2. Discharge system of refrigerant.
3. Disconnect accumulator inlet and outlet connections. Cap or plug open lines immediately.
4. Remove accumulator attaching screws and check amount of oil in accumulator (Refer to System Oil

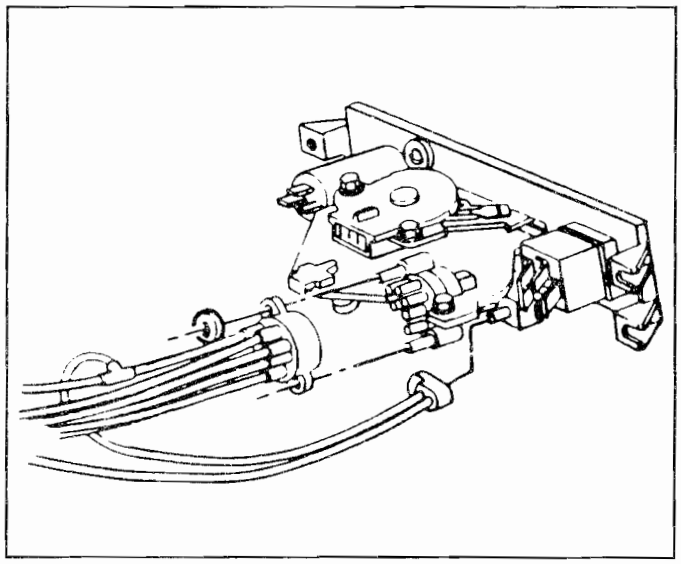


Fig. 1B-21--Control Head Vacuum Line Connections

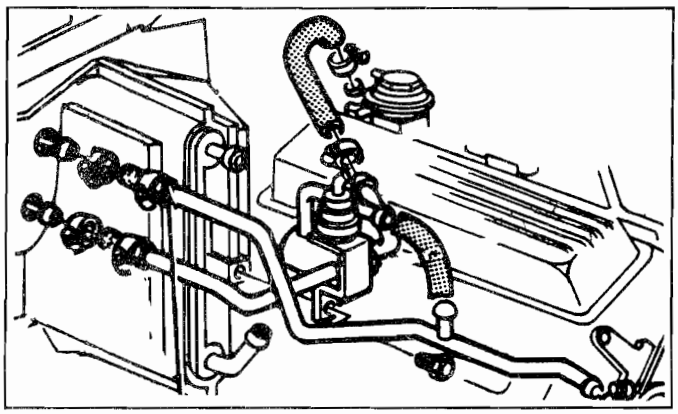


Fig. 1B-22--Vacuum Water Valve

Distribution).

5. Install new accumulator, using clean 525 viscosity refrigerant oil on "O" - ring.
6. Evacuate and recharge system.

VACUUM TANK

During heavy acceleration, the vacuum supply from the inlet manifold drops. The vacuum reservoir, using a check valve, stores vacuum so that under these conditions, vacuum will be available for continuous use.

This system does not incorporate a separate vacuum tank. Vacuum for the air conditioning and heater system is supplied by the bumper tubular reservoir.

VACUUM LINES

Vacuum lines are used on all air conditioning systems. These lines are molded to a connector which is attached to a vacuum control switch on the control head assembly.

In case of leakage or hose collapse, it will not be necessary to replace the entire harness assembly. Replacement can be made by cutting the hose and inserting a plastic connector. If an entire hose must be replaced, cut all hoses off at the connector and then attach hoses directly to the control head vacuum switch.

The vacuum diagram is included with the electrical diagrams found in Section 8A.

BLOWER RESISTOR

Replacement

1. Disconnect the battery ground cable.
2. Disconnect the resistor wiring harness connections.
3. Remove the resistor to evaporator case screws and remove the resistor.
4. To install, reverse Steps 1 thru 3 above.

BLOWER RELAY

Replacement

1. Disconnect negative(-) battery cable.
2. Disconnect electrical connector at relay.
3. Remove relay.
4. To install, reverse Steps 1 through 3.

WATER VALVE

The water valve (Fig. 1B-22) is vacuum operated and is located on the temperature control cable bracket at the distributor assembly. Remove the valve to bracket screws to remove the valve.

ACTUATOR, VACUUM DIAPHRAGM

Replacement

1. Remove actuator linkage, access from under dash, left side.
2. Disconnect vacuum hose.
3. Remove vacuum actuator diaphragm.

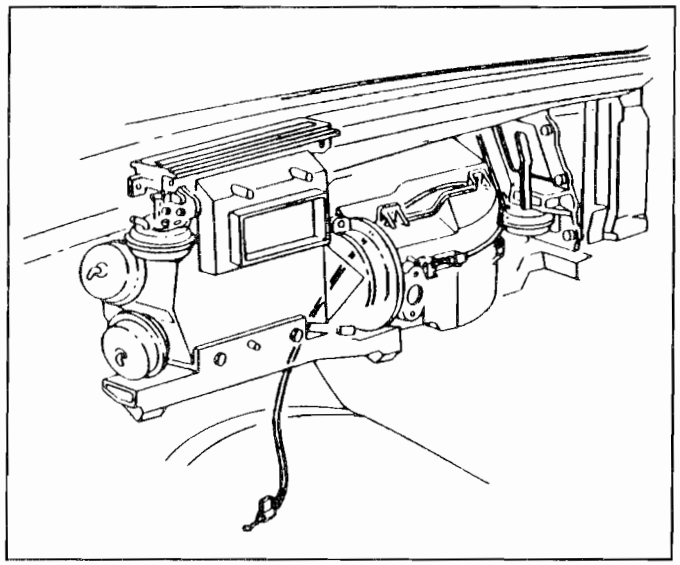


Fig. 1B-23--Temperature Cable Routing

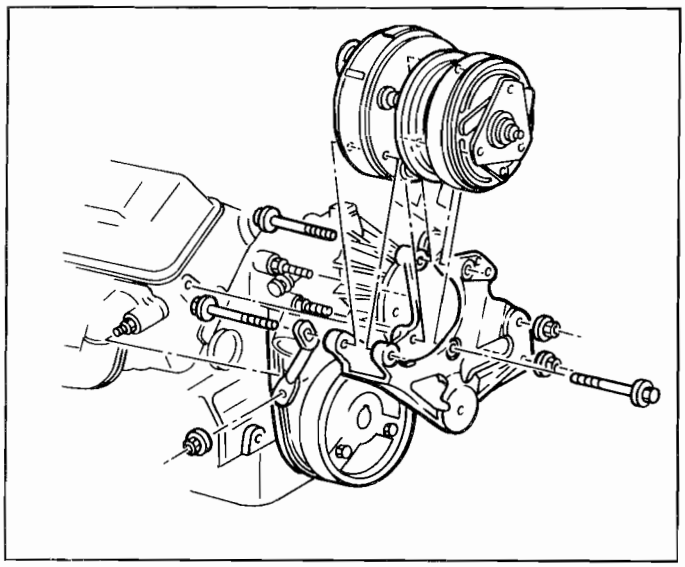


Fig. 1B-24--Compressor Mounting Bracket

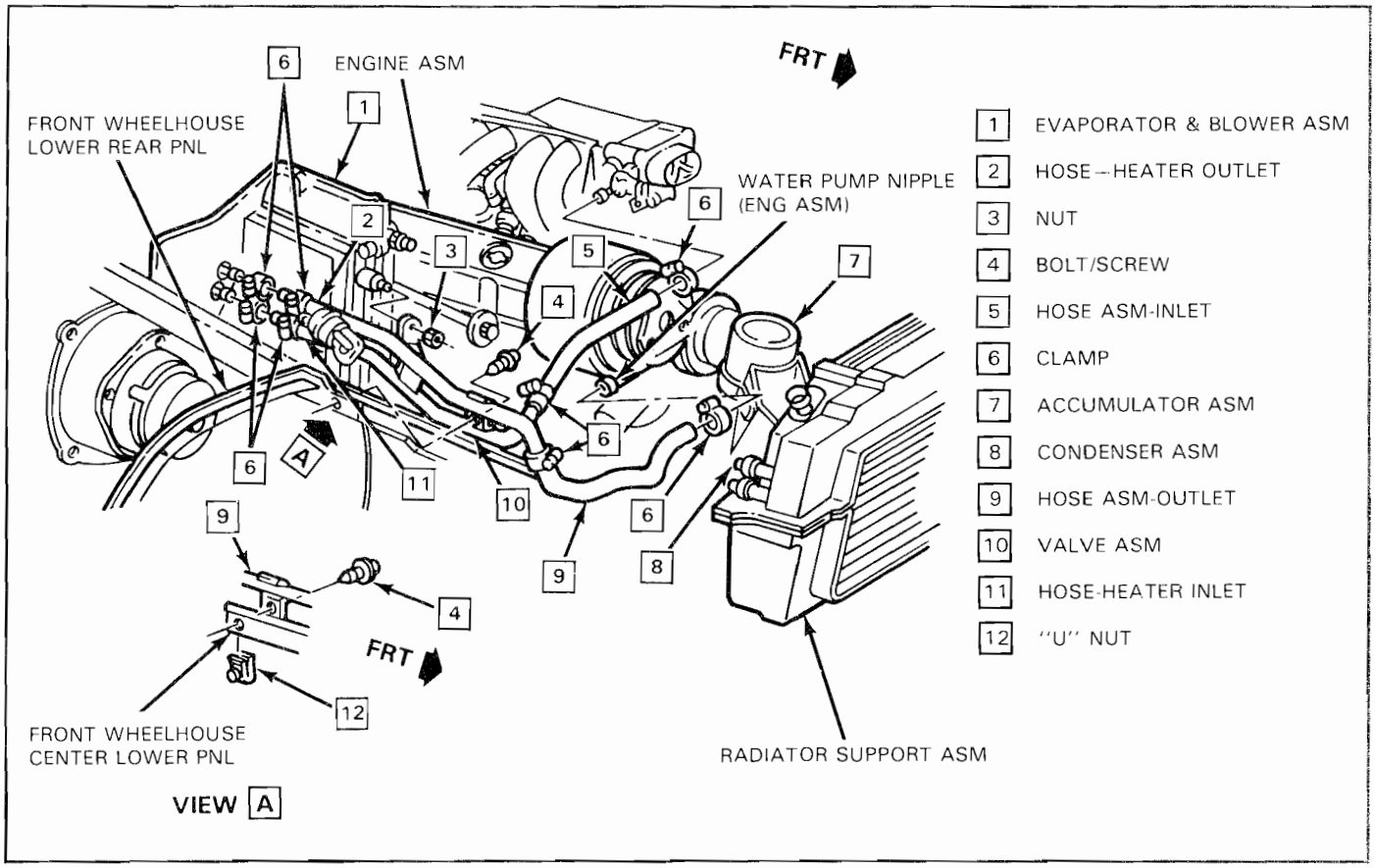


Fig. 1B-25--Heater Hose Routing

Compressor	
Type	4 Cylinder Radial
Displacement	
4 Cylinder Radial	10.0 Cu. In.
Rotation	Clockwise
Compressor Clutch Coil	
Ohms	3.70
Amps (at 80° F)	3.22 @ 12 volts

Fig. 1B-26--Specifications

SECTION 1B1

ELECTRONIC CLIMATE CONTROL

AIR CONDITIONING

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DEFINITIONS

- **Air Distribution System** - combines most of the heating and A/C components into one assembly consisting of the OSA/RECIRC (air intake) valve and actuator, A/C-DEF (upper) valve and actuator, A/C-HTR (lower) valve and actuator, the Temperature (air-mix-blend) valve, blower motor, evaporator and heater core.
- **Actuator** - A vacuum or electric-driven mechanism for moving or controlling something indirectly instead of by hand.
- **Air Conditioning** - the control of temperature, humidity, cleanness and movement of air. Often abbreviated A/C or AC.
- **Ambient** - Air (OSA) that is outside the vehicle.
- **Analog** - An approximation of numerical information derived from a variable input device (like the temperature sensor and signals developed by it) - corresponding point-to-point, value-for-value); unlike digital data which is more accurate.
- **Annunciator** - a device which, when energized by an electric current, emits an audible note and/or displays a visual indication.
- **Bit(es)** - the smallest block of accessible information in a memory system represented by the binary digits 0 to 1.
- **Byte** - a larger grouping of bites representing a word.
- **C.C.O.T. System** - Cycling Clutch Orifice Tube System. The C.C.O.T. System controls evaporator temperature by turning the compressor (clutch) on and off. Also see orifice tube.
- **Comparator** - An electronic device usually a solid-state operational amplifier used to compare two quantities whose output (signal) depends on the result of comparing its two inputs.
- **CPU** - Central Processing Unit.
- **Diaphragm** - Also called actuators. A device that uses the pressure difference between vacuum & air to provide mechanical motion through a link and position the valves to direct the air flow through the A/C module.
- **Duct** - Tubes or channel that carries and directs the air flow to the windshield, instrument panel or floor.
- **ECM** - Electronic Control Module-ECM
- **ESD** - Electro-static discharge
- **ECC** - Electronic Climate Control (A/C) System
- **Heat Sink** - A heat exchanger. Made with a heavy metal base usually having a set of radiating fins to remove heat from mounted components such as power transistors and similar solid-state devices.
- **HVAC** - Heat Vent Air Conditioning (system).
- **I/O** - Input/Output (device or signal used to enter information into the computer system or read information out of it).
- **LSI** - Large Scale Integrated Circuit
- **LED** - Light-emitting diode. Transmits "coherent" light when voltage is applied to its terminals (annunciator).
- **Microprocessor** - A small integrated circuit capable of receiving data, manipulating it, and supplying results - usually of an internally stored program.
- **Mode** - A specifically selected condition or setting that directs the air flow to be heated or cooled then directed to specific outlet ducts.
- **MPU** - Microprocessor Unit
- **OSA** - Outside Air
- **Plenum** - The air intake chamber located on the cowl at the base of the windshield.
- **PWM** - Pulse-Width-Modulated (signal)
- **Quiescent** - At rest or inactive, but still operating.

- **Quiescent Current** - A "standby" or operating current flowing in a circuit or component at "zero" signal, no-drain interval in operation. (Often used as a "keep alive" current supplied to a non-volatile (ROM) memory.)
- **PCB** - Printed Circuit Board.
- **RAM** - Random-access-memory. Allows access time to stored data in memory independent of the CPU's address.
- **Refrigerant** - The chemical used in the system to produce cooling. Refrigerant-12 is used in automobile systems and is sold under such trade names as Freon-12, Genetron-12, Isotron-12, Prestone-12, and etc.
- **Rheostat** - A variable resistor (either a rotary or sliding type).
- **ROM** - Read-only-memory. A non-destructive computer memory in which data or instructions have been permanently stored for use by the machine or user's reference. No information can subsequently be written into memory without using a special "programming" device.
- **Thermistor** - A temperature sensitive resistor that inversely increases (or decreases) in resistance valve with a decrease (or increase) in temperature.
- **Transistor** - A small solid-state electronic device used to amplify and condition a signal or serve as a switch.
- **Valve** - A door that directs or blocks air flow in an A/C system. Valves are operated by electronically-driven linkage or vacuum-motor actuators.

GENERAL DESCRIPTION

SYSTEM OVERVIEW

Temperature settings should be used as guides only. Choose a setting most comfortable to you, no matter what the outside temperature. To set a temperature, press either the "Cool" or "Warm" button. Hold it until you see the temperature you want. The reading will change one degree at a time spaced a half second apart.

The "Cool" button will go down to 65°. If you press it again you see 65°, the setting will jump down to 60° and stay there. From that point, the system will cause maximum cooling. This will override automatic control.

The "Warm" button will go up to 85°. If you press it again after you see 85°, the setting will jump up to 90° and stay there. From that point, the system will cause maximum heating. This will override automatic control. The ETTC system is similar in operation to earlier automatic Heat Vent Air Conditioning (HVAC) systems used on automobiles. However, some differences include:

- a "state-of-the-art" digital microprocessor (MPU) with a programmable memory,
- A diagnostic mode for system self-diagnosis,
- individual in-car and OSA temperature sensor signal inputs to the MPU for improved temperature compensation,
- a digital vacuum-fluorescent display,
- an English-metric conversion capability, and
- a rear window defog key pad switch.

While all ECC systems use an electrically-operated, rheostat-controlled motor to position the temperature door. The (ECC) system electrically activates the auto, bi-level, econ, heat and def modes through the use of vacuum located in the programmer.

The HVAC system's control components include: an A/C Control Head Assembly (Controller), Programmer Assembly, the Blower Power Control Module, an In-Car Temperature Sensor an outside air sensor and the air distribution assembly containing the air flow control valves, the evaporator and heater core. Combined with the cycling clutch orifice tube (CCOT) refrigeration system, the controller regulates blower fan motor speed and generates command signals addressed to the Programmer and Blower Power Control Module.

LED annunciators are illuminated brightly when each switch is pressed. Merely by touching specific buttons, the operator can select the desired HVAC operating mode(s) or temperature settings for:

- one of the five operating modes (Heater, Economy, Automatic, Bi-Level and Defrost),
- WARM or COOL,
- two blower speeds: auto, manaual 0-10.
- rear window defrost (R. DEF) or
- "OFF".

A flashing LED annunciator on the ECC system's faceplate is the first indication that the microprocessor has sensed a problem with the system. Flashing occurs only once for approximately 60 seconds every driving session until the problem has been corrected.

The ECC HVAC system performs normally within an input voltage range from 9 Volts DC to 16 Volts DC. Its MPU can retain data in the non-volatile (ROM) memory down to a battery voltage as low as 4.15 volts DC. When the ECC system or the vehicle has been shut "OFF", the MPU draws a low-standby current of less than 10 mAmps to retain the contents of its RAM (memory).

OFF - In this setting, the system will not let the fan blower motor or the air conditioner compressor run. The system will try to reach the setting you choose. If you choose 70° and it is a cold day, your Corvette's interior will reach the 70° range; but it will take longer because the fan is not running. If it is a hot day, the interior will cool but only down to about half that of the outside temperature. This 70° setting will force all air to the floor outlet in the car.

HTR (HEATER-ECONOMY) - With this setting, all air coming into the car is forced to the floor. The fan blower motor will vary in speed unless you press the ""down" or "up" buttons. In-car temperature will adjust to the setting you choose, unless what you choose is below the outside temperature.

"ECON" (ECONOMY) - By using this setting, the compressor will not run. The system will adjust to the temperature you choose. But it cannot cool the car

colder than the outside temperature. This setting decides automatically the fan blower speed and air outlet positions by the different inputs already mentioned...unless the fan is overridden by the "down" or "up" push buttons.

AUTO (AUTOMATIC) - In this setting, everthing is controlled by all the inputs already discussed. The system will adjust to the temperature range you select, and it will stay here. It will stay at this temperature with the least possible noise level. The fan blower will vary its speed on its own unless you override it with the "down" or "up" push buttons.

B-LEV (BI-LEVEL) - By using this setting, the system will let air into the car only through the (bi-level) heater and air conditioner outlets. This setting will bring the temperature to the range you choose. It will control fan blower speed by using the input signals talked about earlier. Defog side windows on "Bi-Lev". You can override the fan blower speed by using "down" or push buttons.

DEF (DEFOGGER/DEFROSTER) - With this setting, all air is forced to the windshield. The compressor runs by using all the input signals mentioned earlier. The fan blower will turn on to a fixed high speed with no delay. After start-up, you can override the "High" fan blower speed by pushing "down" or "Auto".

R. DEF (REAR DEFOGGER/DEFROSTER) Use this setting when you need to defrost or defog the rear window. The first time you press the button, the unit will run for ten(10) minutes. Then the unit will shut off. After it has been warmed up, when you use this function, it will run for five(5) minutes.

At ignition on, a small amount of air flow is directed to the floor. This purges the heater core and prevents the windshield from fogging. The purge mode derration lasts for 15 seconds and is enabled when the program number is above PGSHFT. If a blower delay is required, the purge mode is entered at the completion of the delay.

Entering manual blower or the front defrost mode will override the purge mode.

(LOW) FAN - This setting will override automatic fan speed. To decrease fan speed, press the "down" and hold until you see the fan speed you want. If you need heat, a timer delay will keep the fan off for three(3) minutes on cold start-ups.

AUTO (AUTOMATIC) FAN - If you use this setting, the controller will choose the fan speed based on the input signals talked about earlier.

(HIGH) FAN - This setting overrides automatic fan speed. To increase fan speed, press the "up" button and hold until you see the fan speed you want. There is no fan blower delay.

EXT TEMP (EXTERIOR TEMPERATURE) By pushing this button, the readout in the box at the right will show the outside temperature instead of the car's inside temperature. Push the "EXT TEMP" button again to return to the normal readout (or press either "Cool' or "Warm"). If you turn the ignition off and back on, the readout will also go back to the car's interior temperature.

For optimum system performance with top removed and/or windows down, use manual control or fan speed. Refer to Figure 1B1-1, System Response.

MAJOR SYSTEM COMPONENTS

A/C Control Head Assembly (Controller)

The controller consists of a electronic printed circuit boards housed in a plastic box attached to the instrument panel (IP). Two circuit boards ... the main central processing board, and the other, the digital display connect to the controller's faceplate

Key Pad Panel Switches (Figure 1B1-1)

Operators of the ECC system use the (13) pressure-sensitive, low-current switches on the flat membrane faceplate to address the CPU of their HVAC mode selection. Each time a switch is depressed the LED will illuminate brightly.

Display Panel

The blue-green, three-segment display's printed circuit (PCB) board contains the vacuum-fluorescent digital display and supporting electronic circuits. It provides a readout of (1) operator selected temperatures, or when "EXT TEMP" key pad is pressed displays the OSA temperature.

Controller Faceplate Lighting

For control head light bulb replacement, refer to control removal section.

Programmer Assembly

The programmer is in the passenger compartment (Figure 1B1-2). It contains:

- five vacuum solenoids
- electronic switching amplifiers and drivers mounted on a printed circuit board.

Three logic, input drive signals (A/C-DEF, BI-LEVEL/TEMP, and OSA-RECIRC) derived by the controller, determine the airflow position "enabling states" of each valve controlled by one of five solenoids (L1, L2, L3, L4, and L5. The programmer accepts these low-current command signals which are initiated by operator-selected HVAC mode key pad switch positions and the two temperature sensor readings.

The programmer, in turn as commanded, energizes specified solenoids with a "clamped" 12 volts DC level by grounding one side of the solenoid through the designated electronic switch (located in the controller on the CPU PC board). Vacuum is then applied to the selected vacuum-motor actuators which reposition any one, two or all three valves to control air flow in the A/C module.

No attempt should be made to repair the Programmer's electronic circuits or vacuum solenoids. Programmer replacement, if found necessary, should only be to disconnect and remove the malfunctioning programmer and replace it with a properly functioning exchange unit.

NOTE: The programmer must be connected electrically (under load) to the controller when testing the programmer for abnormal power levels.

Vacuum Solenoids

Both the OSA/RECIRC (L1) and DEF/AC (L2) vacuum solenoids are energized when the driver signals from the Controller [inputted at pins N (OSA/RECIRC) and P (DEF/AC)] are pulled below 1.25 volts.

When the input driver signal at pin T (AIR-BI LEVEL-HTR) is greater than 4 volts DC, Heater solenoid (L3) is enabled and AIR solenoid (L1) is not energized. Whereas, both solenoids (Heater-L4 and Air-L2) are "OFF" (not energized) when the input signal is 2.25V.

At input signals of less than 1.25 volts, Heater solenoid (L4) is OFF; while AIR solenoid (L1) is energized.

Temperature Door Actuator

Temperature valve linkage to the actuator consists of a plastic crank arm pressed over the DC motor's output shaft. A threaded-adjustable link rod is snapped into the retainer on the crank arm (Figure 1B1-2). The reversible DC motor, inside the programmer's plastic case, actuates its rotary shaft to drive the link rod for positioning the (temp) valve opening.

NOTE: To function properly the vacuum solenoids in the programmer must be mounted in the position as shown (Figure 1B1-2).

TEMPERATURE SENSORS

Automatic control of operator-selected (HVAC) in-car temperature levels depends in large part on two temperature sensors, an in-car sensor and an Outside Air (OSA) sensor. Both sensors are temperature sensitive resistors called "thermistors". Each sensor develops a low current signal which is directly proportional to actual (OSA and In-Car) temperature readings. This temperature information is used by the controller's MPU to derive command signals sent to the ECC system's programmer.

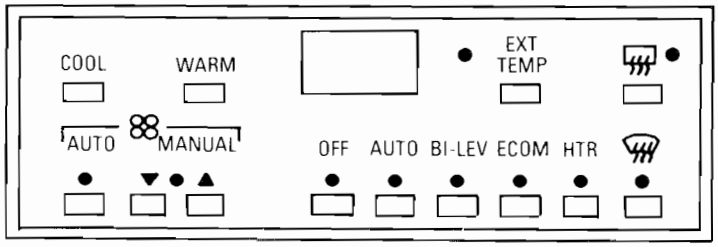
In-Car Sensor

The In-Car sensor is located in the bow asm-roof center.

Due to its design, a low current signal signifying actual in-car temperature is generated. This signal is fed back to the control head, which in turn will control the blower speed and temperature door to acquire the desired temperature. Refer to Section 8A, Electrical Schematics.

Outside Air (Ambient) Sensor

The OSA is mounted on the center bracket below the upper radiator support bracket near the bottom of the A/C Condenser in front of the radiator. Its electrical harness is routed along the lower support tie-bar to the OSA harness connector on the left front bulkhead (Figure 1B1-5).



STEP	CONTROL SETTINGS			SYSTEM RESPONSE					
	MODE CONTROL	TEMPERATURE SETTING	FAN SETTING	BLOWER SPEED	HEATER OUTLETS	A/C OUTLETS	DEFROSTER OUTLETS	S.W.D.** OUTLETS	* SEE NOTES
1	OFF	60	MANUAL 1	OFF	NO AIR FLOW	NO AIR FLOW	NO AIR FLOW	NO AIR FLOW	
2	AUTO	60	MANUAL 1	LOW	NO AIR FLOW	AIR FLOW	NO AIR FLOW	NO AIR FLOW	
3	AUTO	60	MAN 1 TO AUTO	LOW TO HIGH	NO AIR FLOW	AIR FLOW	NO AIR FLOW	NO AIR FLOW	A
4	BI-LEVEL	60	AUTO	HIGH	AIR FLOW	AIR FLOW	AIR FLOW	NO AIR FLOW	
5	ECON	60	AUTO	HIGH	NO AIR FLOW	AIR FLOW	NO AIR FLOW	NO AIR FLOW	B
6	HTR	90	AUTO	HIGH	AIR FLOW	NO AIR FLOW	MINIMAL AIR FLOW	AIR FLOW	C
7	DEF	90	AUTO	HIGH	MINIMAL AIR FLOW	NO AIR FLOW	AIR FLOW	AIR FLOW	C

** ONLY A SMALL QUANTITY OF AIR WILL BE DISCHARGED AT THESE OUTLETS

COOLING FUNCTIONAL TEST

1. DOOR OR WINDOWS CLOSED.
2. TEMPERATURE INDICATORS AT CONDENSER INLET AND RH UPPER COOLING OUTLET.
3. CLOSE LH SIDE, CENTER, AND LOWER RH COOLING OUTLETS.
4. START ENGINE AND RUN AT 2000 RPM.
5. SET TEMPERATURE TO 60° (MAX COOL) BY PRESSURE COOL BUTTON.
6. AFTER ONE MINUTE THE AIR TEMPERATURE DROP AT THE RH UPPER COOLING OUTLET SHOULD BE AS FOLLOWS:

CONDENSER INLET TEMP. (F °)	70	80	90-100
RH UPPER OUTLET TEMP. DROP (F ° MINIMUM)	20	25	30

NOTES*

A. NOTICEABLE BLOWER SPEED INCREASE MUST OCCUR FROM MANUAL (1) TO AUTO.

B. LISTEN FOR REDUCTION OF AIR NOISE DUE TO RECIRCULATION DOOR CLOSING.

C. CHECK FOR SMALL AMOUNT OF AIR FLOW AT S.W.D. OUTLETS.

Figure 1B1-1 Control Head System Response

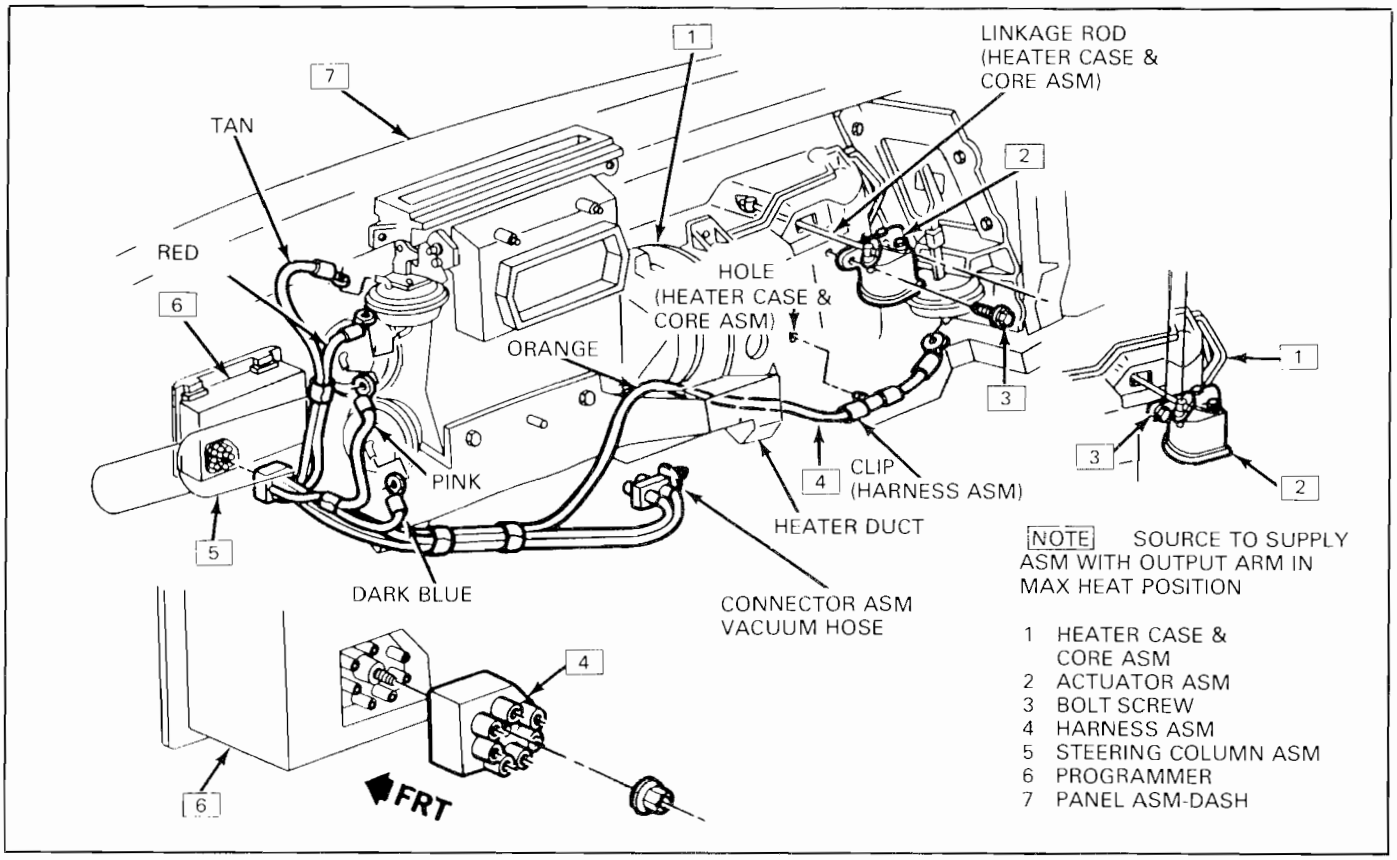


Figure 1B1-2 Vacuum Line Mounting and Temperature Door Actuator

DIAGNOSIS

There are 9 diagnostic modes as described below. Diagnostic mode number 8 is the most commonly used mode for diagnosing this system. The diagnostic mode is entered while pressing the rear defrost button and then pressing and releasing the manual up button. Once the diagnostic mode is enabled, the mode number may be changed by pressing the warmer button. The contents of the mode may be displayed by pressing the cooler button. The mode number is displayed preceded by a minus sign.

- Mode #1 - Program Number
- Mode #2 - In-Car Thermistor
- Mode #3 - Ambient Correction
- Mode #4 - Blower Number
- Mode #5 - Outside Temp Thermistor
- Mode #6 - Feedback Pot Position
- Mode #7 - Calculated Door Position
- Mode #8 - System Faults
- Mode #9 - Software Version Number

System Faults - A system fault is indicated by a flashing annunciator. If there is a problem with the Ambient sensor, In-car sensor, or the Feedback potentiometer, the EXT TEMP annunciator will flash for approximately 60 seconds, upon ignition on. The flashing annunciator will reoccur upon ignition on until the system problem has been corrected. To further investigate a system problem, a diagnostic data word can be examined. The diagnostic data word is displayed by entering diagnostic Mode #8. The diagnostic data word is a number that indicates the failure mode. Faults can be determined by evaluating the Binary Equivalent of the diagnostic data word displayed. A "1" in a column is an indication of an error of that category. The Diagnostic Mode can be exited by depressing any mode button on the ECC control face. For further diagnosis, refer to Section 8A.

ON-CAR SERVICE

CONTROL PANEL

Remove and Install (Figure 1B1-3)

1. Disconnect battery ground cable.
2. Remove instrument panel screws securing trim plate and remove trim plate.
3. Remove screws securing front floor console trim plate and remove trim plate.
4. Remove 4 screws securing control assembly and remove control assembly.
5. To install, follow removal procedures in reverse order.

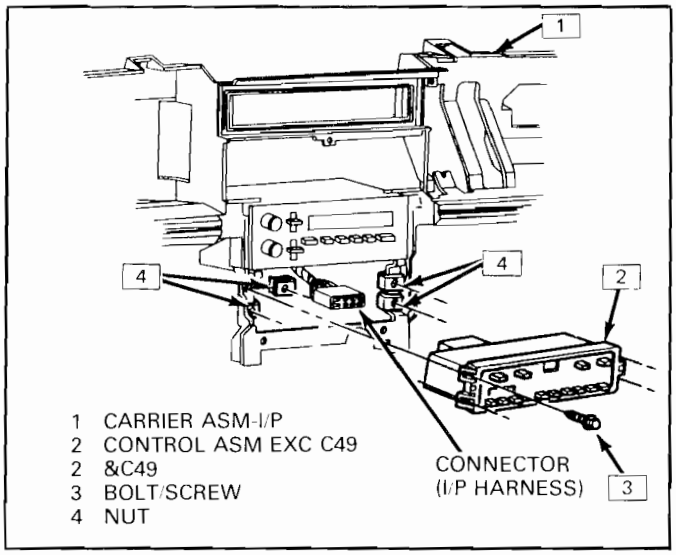


Figure 1B1-3 A/C Control Head

IN CAR TEMPERATURE SENSOR

Remove and Install (Figure 1B1-4)

1. Disconnect battery ground cable.
2. Remove the removable roof.
3. Remove rear hatch window trim panel.
4. Disconnect and remove the bolts securing the sensor.
5. To install, follow removal procedure in reverse order.

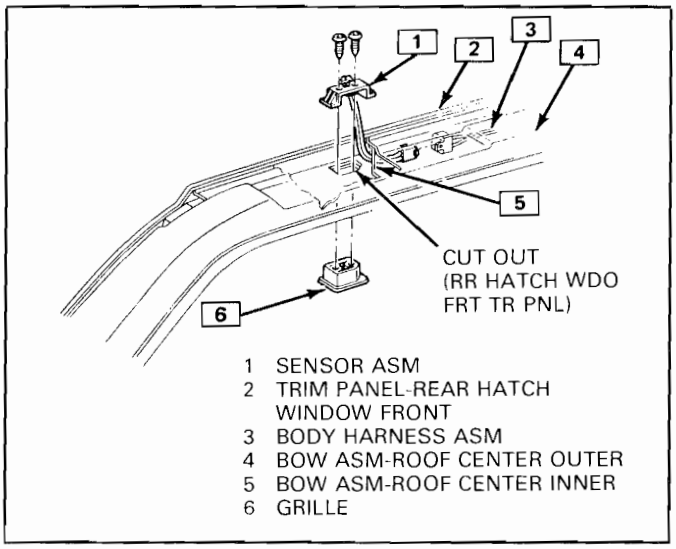


Figure 1B1-4 In Car Sensor

OUTSIDE TEMPERATURE SENSOR

Remove and Install (Figure 1D1-5)

1. Disconnect battery ground cable.
2. Disconnect temperature sensor.
3. Remove bolt securing temperature sensor.
4. To install, follow removal procedure in reverse order.

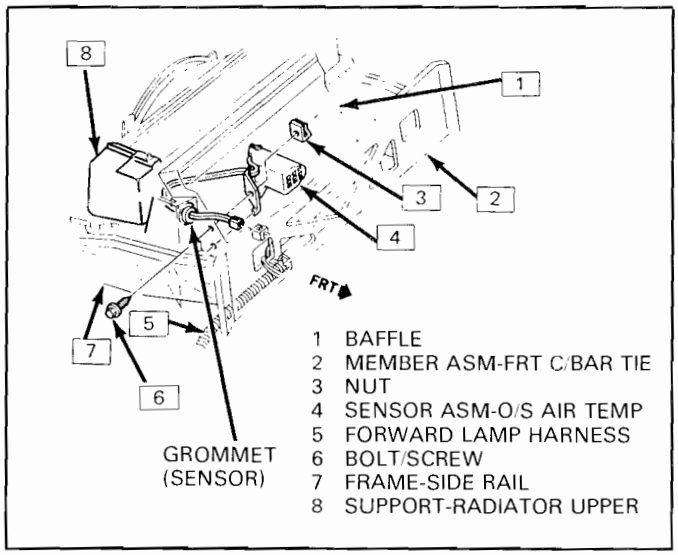


Figure 1B1-5 Outside Temperature Sensor

A/C PROGRAMMER

Remove and Install (Figure 1B1-6)

1. Disconnect battery ground cable.
2. Remove lowerleft hand trim pad.
3. Disconnect electrical connectors.
4. Remove vacuum hose harness.
5. Remove screw securing programmer and remove programmer.
6. To install, follow removal procedure in reverse order.

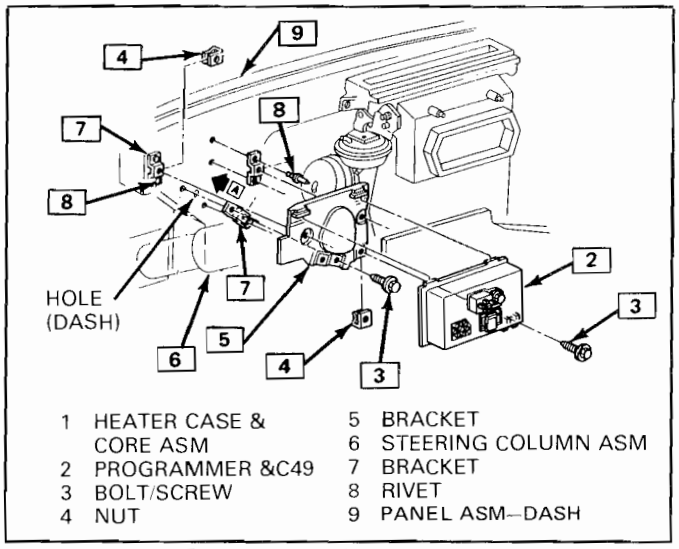


Figure 1B1-6 Programmer

TEMPERATURE DOOR ACTUATOR

Remove and Install (Figure 1B1-2)

1. Disconnect battery ground cable.
2. Remove lower right hand trim pad.
3. Disconnect temperature door actuator connector.
4. Disconnect all ECM connectors.
5. Disconnect actuator pad.
6. Remove bolt securing actuator and remove actuator.
7. To install, follow removal procedure in reverse

SECTION 1D1

R-4 AIR CONDITIONING COMPRESSOR OVERHAUL

For Compressor REMOVAL AND INSTALLATION, see Air Conditioning Section 1B. For DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR A/C SYSTEMS, see Air Conditioning Section 1B.

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GENERAL DESCRIPTION

For 1987, two clutch drivers are used on the R-4 air conditiong compressor that incorporate a short shaft design. The four-pole driver uses a v-groove pulley, while the six-pole driver uses a poly-groove pulley. Both of these drivers have M22 X 1.5 threads, while past models had 7/8-14 UNF threads. A comparison of the two drivers for new (short shaft) and old (long shaft) designs is shown in Figure 3. Figure 4 shows a cross section comparison of the new (short shaft) and old (long shaft) designs. The type of clutch driver must be identified prior to starting overhaul procedures.

When servicing the compressor, it is essential that steps be taken to prevent dirt or foreign material from getting on or into the compressor parts and system during disassembly or reassembly. Clean tools and clean work area are very important for proper service. The compressor connection areas and the exterior of the compressor should be cleaned off as much as possible prior to any "on car" repairs or removal of the compressor for workbench service. The parts must be kept clean at all times and any parts to be reassembled should be cleaned with trichloroethane, naphtha, stoddard solvent, kerosene or equivalent solvent and blown dry with dry air. When necessary to use a cloth on any part, it should be of a nonlint producing type.

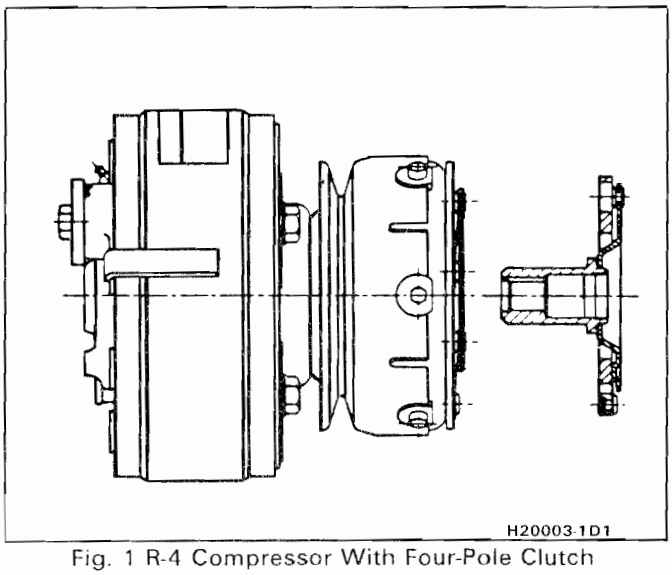


Fig. 1 R-4 Compressor With Four-Pole Clutch

Although certain service operations can be performed without completely removing the compressor from the vehicle, the operations described are based on bench over-haul with the compressor removed from the vehicle. They have been prepared in order of accessibility of the components. If compressor

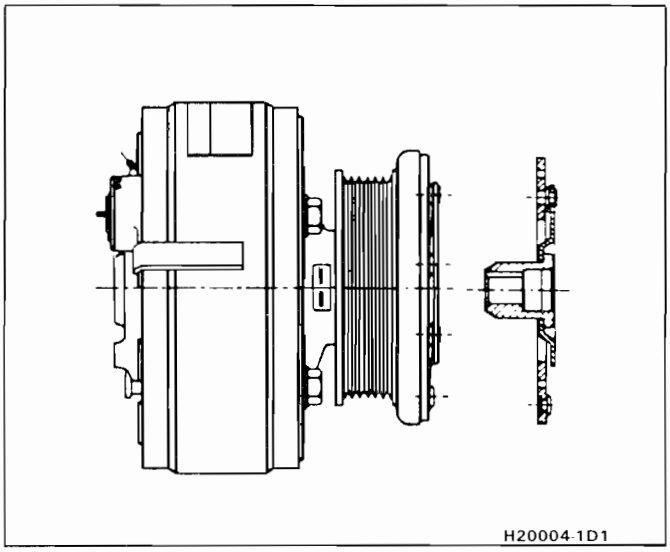


Fig. 2 R-4 Compressor With Six-Pole Clutch

is removed from brackets but not disconnected from lines and hoses, the system is not discharged. Pad fender skirt and secure compressor near top of fender skirt with wire, rope, etc. when performing on-car service.

When the R-4 compressor is removed from the vehicle for servicing, the amount of oil remaining in the compressor should be drained, measured and recorded. This oil should then be discarded and the same amount of new 525 viscosity refrigerant oil added to the compressor (See Refrigerant Oil Distribution" in the Air Conditioning Section 1B).

SERVICE PROCEDURES

MINOR REPAIR PROCEDURES, R-4 COMPRESSOR

THE FOLLOWING OPERATIONS TO THE R-4 COMPRESSOR CLUTCH PLATE AND HUB, ROTOR AND BEARING, AND COIL & PULLEY RIM ARE COVERED AS "MINOR" BECAUSE THEY MAY BE PERFORMED WITHOUT FIRST PURGING THE SYSTEM OR REMOVING THE COMPRESSOR FROM THE VEHICLE.

The two types of drive systems used on the R-4 Compressor (V-groove type and poly-groove type) affect only minor repair procedures and are so noted where required. Major repair procedures are not affected by the type of drive system.

The Compressor Shaft Seal assembly, and Pressure Relief Valve may also be serviced WITHOUT REMOVING THE COMPRESSOR from the vehicle but these operations are covered later in this section as MAJOR REPAIR PROCEDURES because the system must be discharged, evacuated and recharged to complete service.

Illustrations used in describing these operations show the compressor removed from the vehicle only to more clearly illustrate the various operations.

When servicing the compressor, remove only the necessary components that preliminary diagnosis indicates are in need of service. Refer to the AIR CONDITIONING section and Fig. 4 and Fig. 5 for information relative to parts nomenclature and location.

Removal and installation of external compressor components and disassembly and assembly of internal components must be performed on a clean workbench. The work area, tools and parts must be kept clean at all times.

CLUTCH PLATE AND HUB ASSEMBLY

CLUTCH PLATE AND HUB ASSEMBLY INSTALLATION AND REMOVAL PROCEDURES FOR THE SIX-POLE CLUTCH ARE THE SAME AS THE FOUR-POLE CLUTCH WITH THE EXCEPTION OF THE CLUTCH HUB HOLDING TOOL. FOR FOUR-POLE CLUTCH USE J-25030. FOR SIX-POLE CLUTCH USE J-33027.

Remove or Disconnect

1. If compressor is on the car, loosen compressor mounting brackets, disconnect the compressor drive belt and reposition the compressor for access, if necessary.

If c ompressor has been removed from the car, attach the compressor to Holding Fixture J-25008-A and clamp the Holding Fixture in a vise (Fig. 7).

- Compressor mounting holes are metric. Use proper metric bolts with holding fixture J-25008-A.

2. Keep the clutch hub from turning with the Clutch Hub Holding Tool J-25030/J-33027 remove, and discard the shaft nut, using Thin Wall Socket J-9399, Fig. 8.

3. Thread the Clutch Plate and Hub Assembly Remover J-33013-B into the hub. Hold the body of the Remover with a wrench and turn the center screw into the Remover body to remove the Clutch Plate and Hub assembly (Fig. 9).

4. Remove the shaft key.

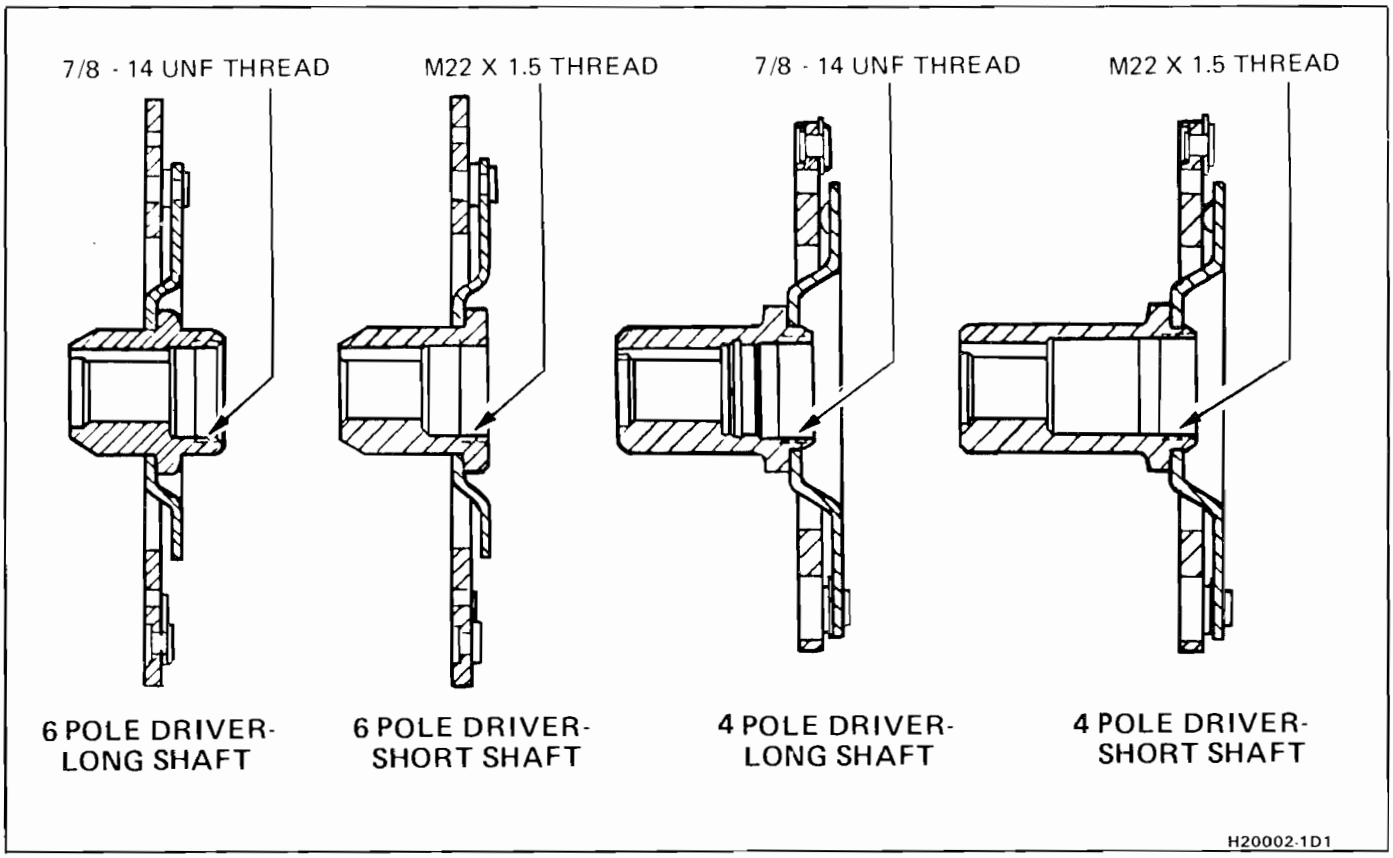


Fig. 3 R-4 Compressor Clutch Drives - New vs. Old Design

Install or Connect

1. Install the shaft key into the hub key groove (Fig. 10). Allow the key to project approximately 4. 8mm (3/16") out of the keyway.
   The shaft key is curved slightly to provide an interference fit in the shaft key groove of the hub.
2. Be sure the frictional surface of the clutch plate and the clutch rotor are clean before installing the Clutch Plate and Hub assembly.
3. Align the shaft key with the shaft keyway and place the Clutch Plate and Hub assembly onto the compressor shaft.

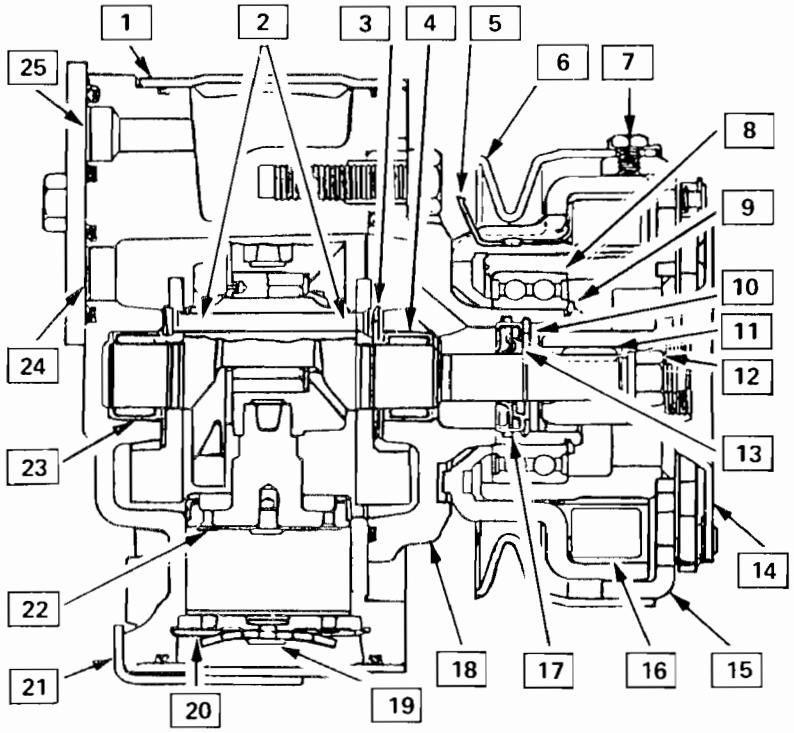
   NOTICE: To avoid internal damage to the compressor, do not drive or pound on the clutch hub or shaft.

4. Install the Clutch Plate and Hub Installer J-9480-B as illustrated in Fig. 11.
5. Hold the hex portion of the Installer Body J-9480-B with a wrench and tighten the center screw to press the hub onto the shaft until there is a .5mm - 1.0mm (.020"-.040") inch air gap between the frictional surfaces of the clutch plate and clutch rotor.
6. Install a new shaft nut with the small diameter boss of the nut against the crankshaft shoulder, using Thin Wall Socket J-9399. Hold the Clutch Plate and Hub assembly with Clutch Hub Holding Tool J-25030/J-33027 and tighten to 14 N·m (10 lb. ft.) torque, using a 0-60 N·m (0-25 lb.ft.) torque wrench.
7. If operation is performed with compressor on car, connect drive belt, tighten mounting brackets and adjust belt tension.

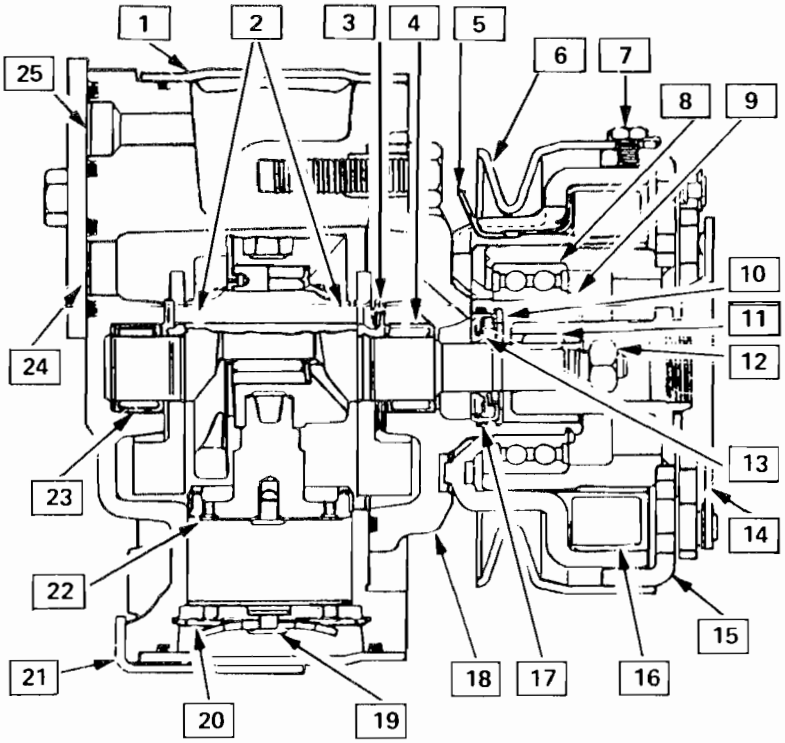
CLUTCH ROTOR AND/OR BEARING - V-GROOVE PULLEY - FOUR-POLE CLUTCH

Remove or Disconnect

1. Remove the Clutch Plate and Hub assembly as described in R-4 COMPRESSOR CLUTCH PLATE & HUB ASSEMBLY removal procedure.
2. Remove Rotor and Bearing assembly retaining ring, using Snap Ring Pliers J-6083, Fig. 12. Mark the location of the clutch coil terminals.
   If only the Clutch Rotor and/or Rotor Bearing are to be replaced, bend the lockwashers away from the pulley rim mounting screws (see Fig. 13), and remove the six (6) mounting screws and special lock washers before proceeding with Step 3. Discard the lock washers.
3. Install Rotor and Bearing Puller J-25031 down into the rotor until the Puller arms engage the recessed edge of the rotor hub. Hold the Puller and arms in place and tighten the Puller screw against the Puller Guide to remove the Clutch Rotor and Bearing assembly (Figs. 13 and 14), being careful not to drop the Puller Guide.
4. If the pulley rim mounting screws and washers were removed in Step 2, only the Clutch Rotor and Bearing assembly will be removed for replacement. The Clutch Coil and Housing



FOUR POLE CLUTCH–
LONG SHAFT (OLD DESIGN)



FOUR POLE CLUTCH–
SHORT SHAFT (NEW DESIGN)

1–COMPRESSOR SHELL

2–ROLL PINS

3–THRUST AND BELLEVILLE WASHER

4–MAIN BEARING- FRONT

5–CLUTCH COIL TERMINALS

6–PULLEY RIM

7–PULLEY RIM MOUNTING SCREW AND LOCKWASHER

8–ROTOR BEARING

9–ROTOR BEARING RETAINER

10–SEAL SEAT RETAINER

11–SHAFT KEY

12–SHAFT NUT

13–SHAFT SEAL

14–CLUTCH DRIVE ASSEMBLY

15–ROTOR AND HUB ASSEMBLY

16–CLUTCH COIL AND HOUSING ASSEMBLY

17–SEAL SEAT O-RING

18–FRONT HEAD

19–VALVE PLATE ASSEMBLY

20–VALVE PLATE RETAINING RING

21–SHELL RETAINER

22–PISTON ASSEMBLY

23–MAIN BEARING - REAR

24–SUCTION PORT

25–DISCHARGE PORT

H20001-1D1

Fig. 4 R-4 Compressor Cross Section - Long vs. Short Shaft Design

1–RETAINER RING
2–SHAFT SEAL
4–O-RING, SEAL SEAT
5–SHAFT SEAL KIT
6–SCREW AND WASHER ASSEMBLY FRONT HEAD MOUNTING
7–FRONT HEAD
8–MAIN BEARING
9–RING SEAL, FRONT HEAD TO CYLINDER
10–SHELL
11–O-RING, CYLINDER TO SHELL
12–THRUST WASHER
13–BELLEVILLE WASHER
14–THRUST WASHER KIT
15–CYLINDER AND SHAFT ASSEMBLY
16–RETAINER RING
17–VALVE PLATE
18–SHIPPING PLATE
19–SCREW
20–O-RING SUCTION-DISCHARGE PORTS
21–PRESSURE RELIEF VALVE
22–O-RING, PRESSURE RELIEF VALVE
23–SHAFT NUT
24–CLUTCH HUB KEY
25–CLUTCH DRIVE ASSEMBLY
26–RETAINER RING
27–ROTOR
28–ROTOR BEARING
29–ROTOR AND BEARING ASSEMBLY
30–COIL AND HOUSING ASSEMBLY
31–PULLEY RIM MOUNTING SCREW
32–PULLEY RIM

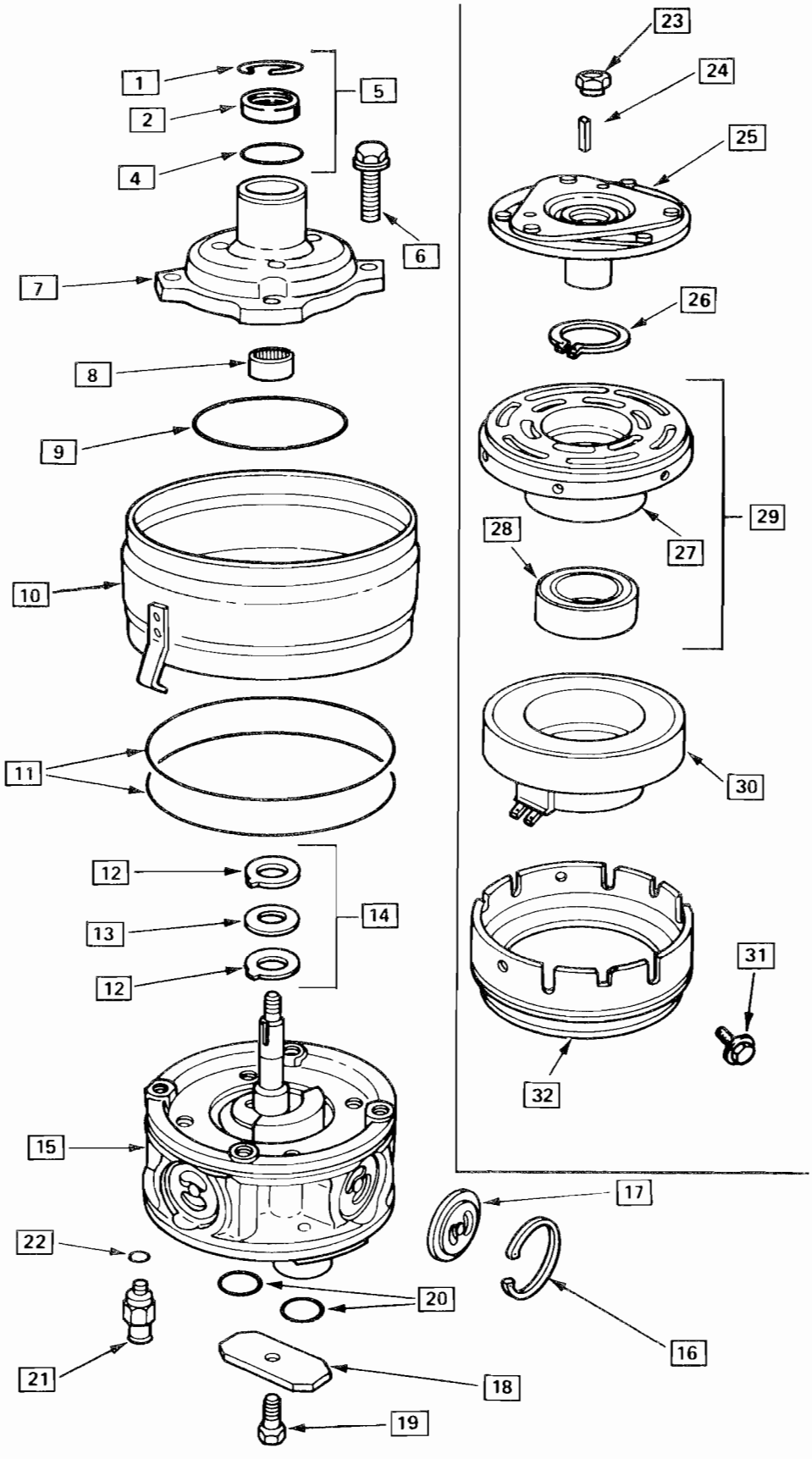


Fig. 5 R-4 Compressor Disassembled View

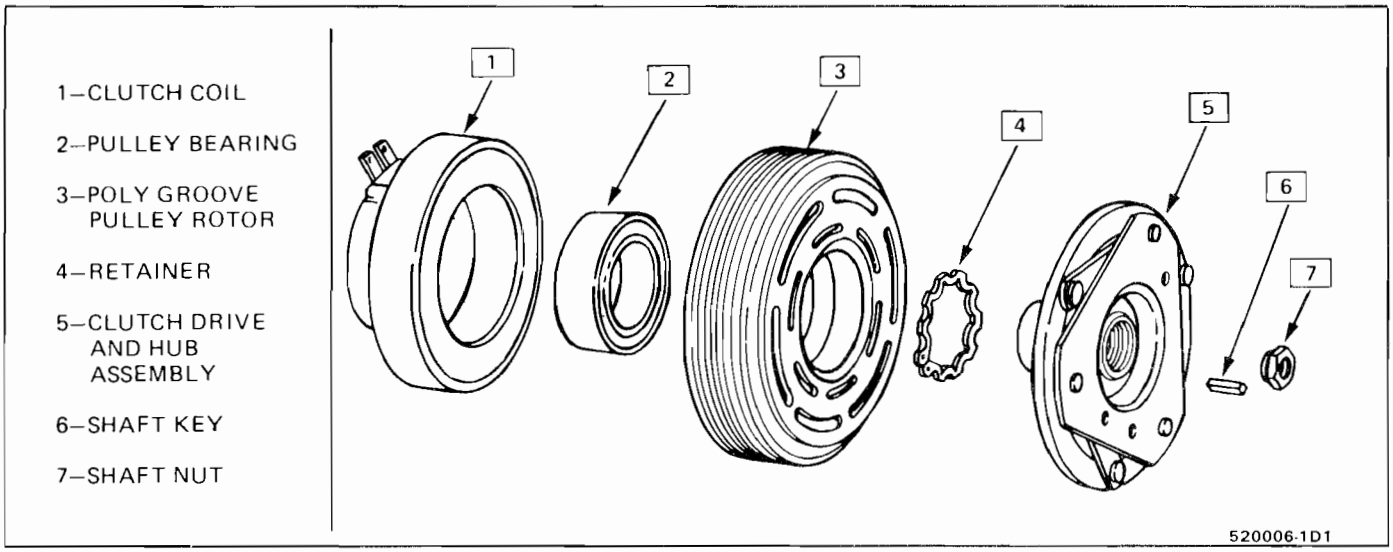


Fig. 6 Disassembled View of Poly Groove Pulley Drive

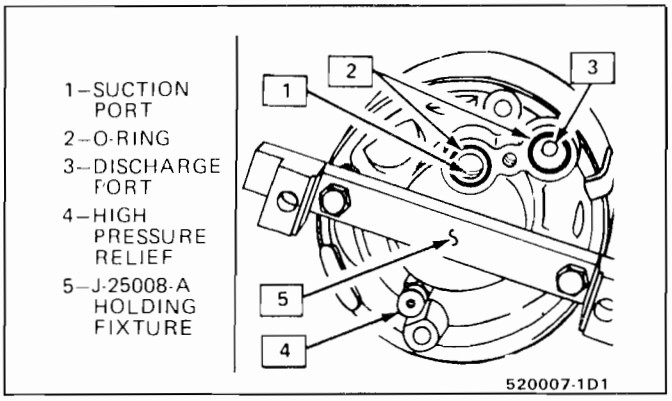


Fig. 7 Compressor In Holding Fixture

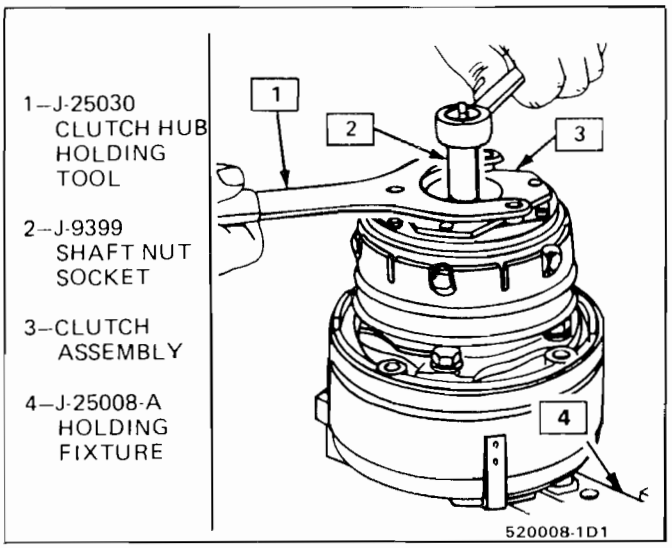


Fig. 8 Removing Shaft Nut

assembly is pressed onto the Front Head of the compressor and will not be removed unless the pulley rim mounting screws are left securely in place and the pulley rim pulls the Coil and Housing assembly off with the total Clutch Rotor and Pulley Rim Assembly.

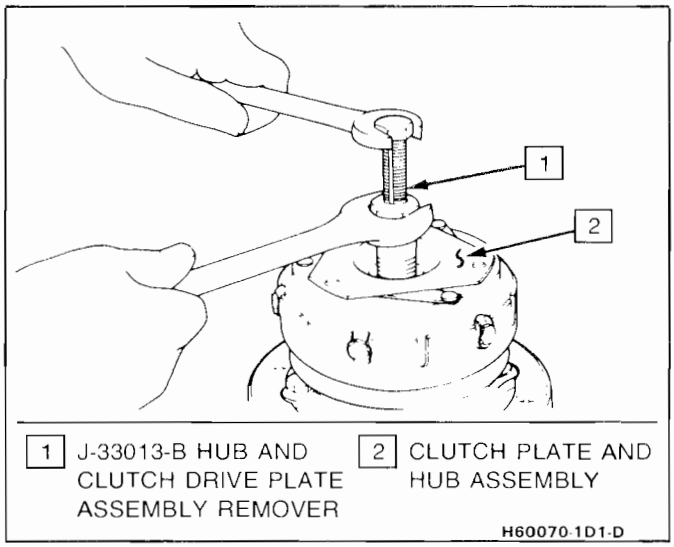


Fig. 9 Clutch Plate & Hub Asm. Removal

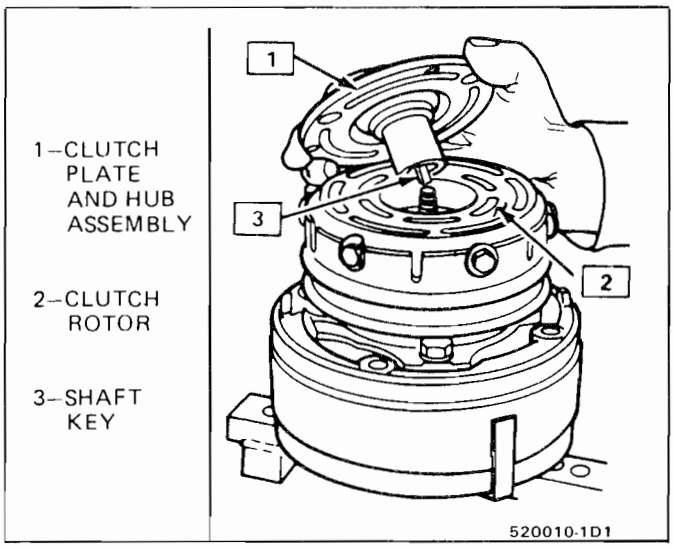


Fig. 10 Installing Shaft Key

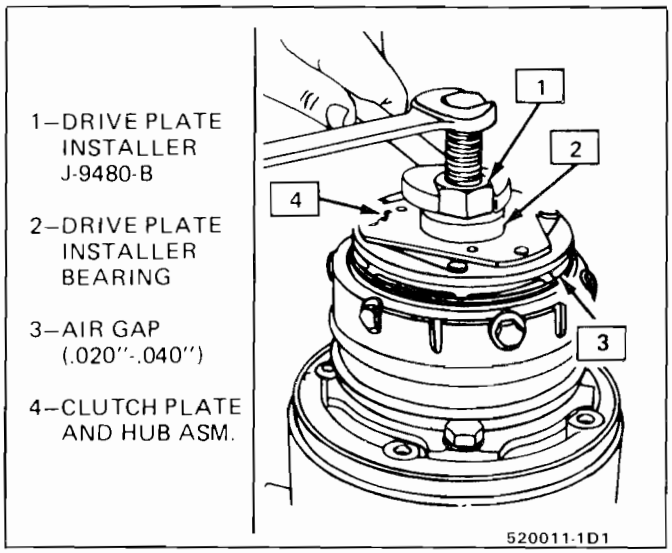


Fig. 11 Installing Clutch Plate & Hub Asm.

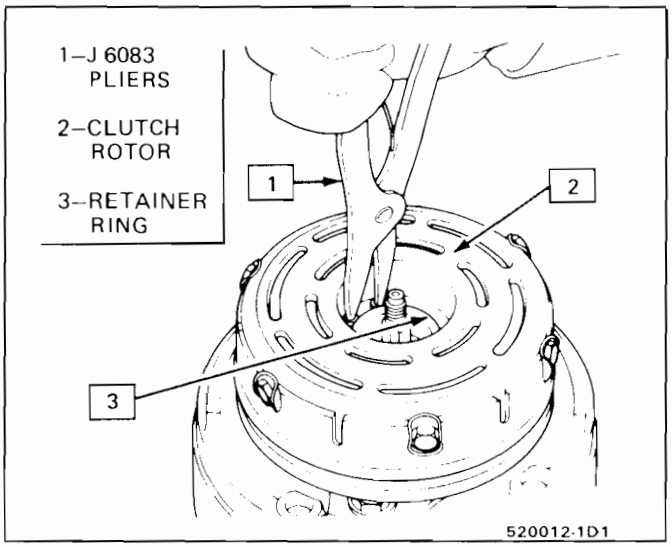


Fig. 12 Removing Rotor & Bearing Asm. Retainer Ring

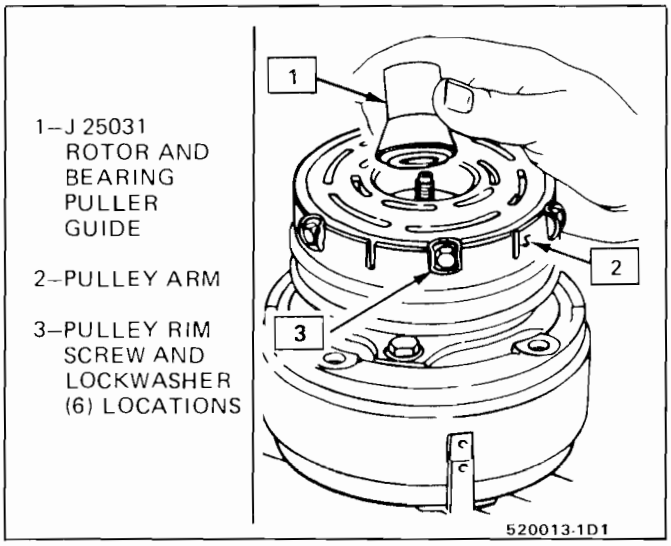


Fig. 13 Installing Rotor & Bearing Puller Guide

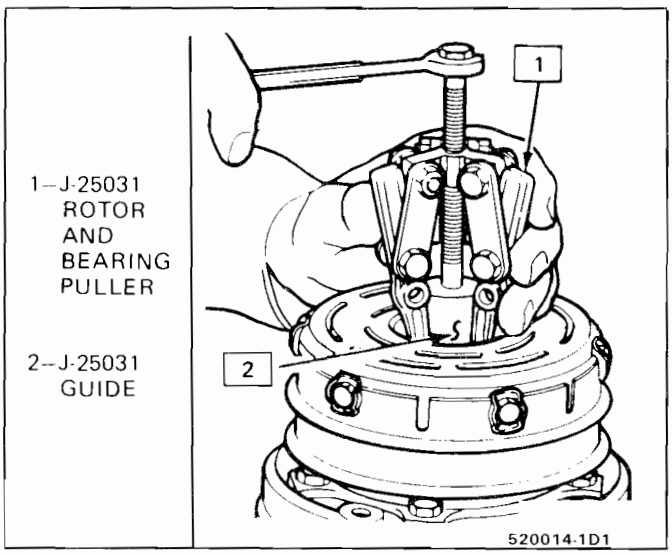


Fig. 14 Removing Clutch Rotor Asm.

5. Place the Rotor and Bearing assembly on blocks as shown in Fig. 15. Drive the bearing out of the rotor hub with Rotor Bearing Remover J-9398-A.

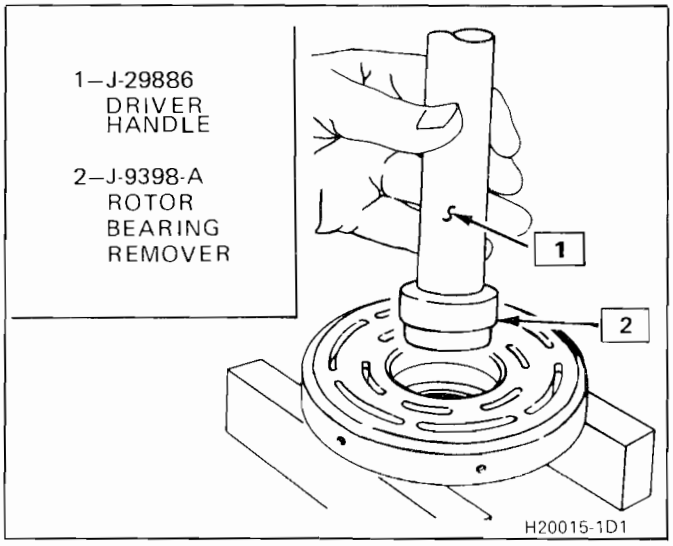


Fig. 15 Clutch Rotor Bearing Removal

It is not necessary to remove the staking at the rear of the rotor hub to remove the bearing. However, it will be necessary to file away the old stake metal for proper clearance for the new bearing to be installed into the rotor bore, or the bearing may be damaged (see Fig. 16).

Install or Connect

1. Place the Rotor and Hub assembly face down on a clean, flat and firm surface.
2. Align the new bearing squarely with the hub bore and using Pulley and Bearing Installer J-9481-A with Universal Handle J-29886, drive the bearing fully into the hub (Fig. 17). The Installer will apply force to the outer race of the bearing if used as shown.
3. Using a center punch with a 45° angle point, stake 1.1 - 1.4mm (.045"-.055" deep) the bearing in

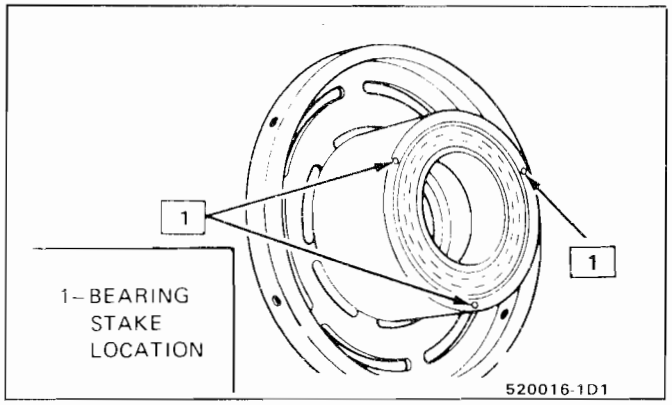


Fig. 16 Rotor & Bearing Asm.

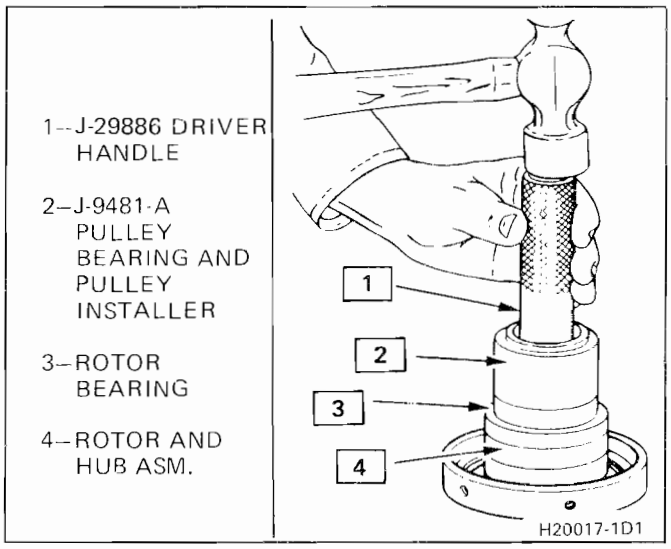


Fig. 17 Installing Clutch Rotor Bearing

three places 120° apart as shown in Fig. 16, but do not stake too deeply to avoid distorting the outer race of the bearing.

4. Replace rotor and bearing assembly.

On Car

A. Position the Rotor and Bearing assembly on the front head.

B. With Rotor & Bearing Installer J-26271-A (without driver handle) in position and Rotor and Bearing assembly aligned with the Front Head as shown in (Fig. 18), drive the assembly part way onto the head.

C. Plug clutch coil connector onto Clutch Coil.

D. Position the Clutch Coil so the three (3) locating tabs will align with the holes in the head and continue to drive the Rotor and Bearing assembly onto the front head.

E. Install the retainer ring (Fig. 12).

F. Reassemble the Clutch Plate and Hub with the shaft key onto the shaft with Installer J-9480-B until .5 to 1.0mm (.020" to .040") air gap is obtained.

G. Install shaft lock nut. Torque to 14 N·m (10 lb. ft.).

On Bench

Reassemble the Rotor and Bearing assembly to the front head of the compressor using Rotor & Bearing Installer J-26271-A. With Installer assembled to the Universal Handle J-29886, as shown in Fig. 21, force will be applied to the inner race of the bearing and the face of the rotor when installing the assembly onto the front head of the compressor.

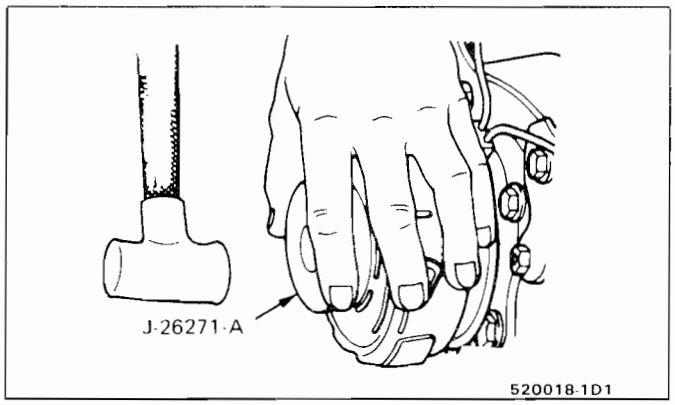


Fig. 18 Installing Rotor and Bearing Asm. (On Car)

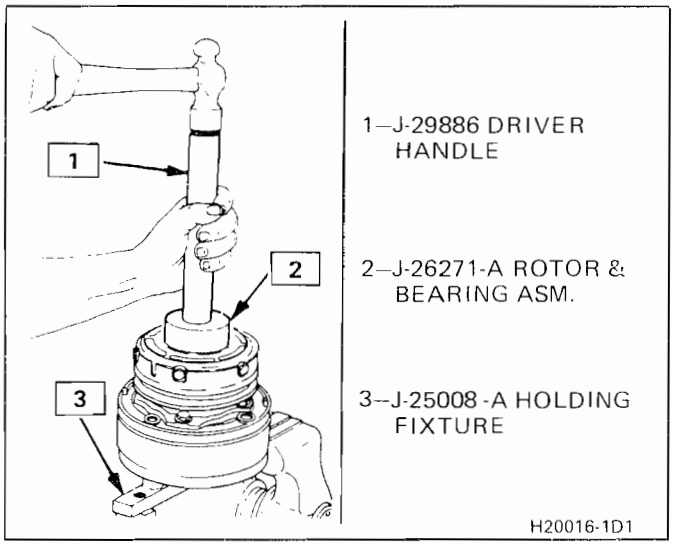


Fig. 19 Installing Rotor & Bearing Asm. V-Groove Type

5. Install rotor and bearing assembly retainer ring, using Snap Ring Pliers J-6083 (see Fig. 12).

6. Apply sealer (Loctite RC-75, Loctite 601 or equivalent) to threads of pulley rim mounting screws. Install screws and new special lock washers but do not torque the screws.

7. Rotate the pulley rim and rotor to insure that pulley rim is rotating "in-line." If pulley rim is distorted (does not rotate in-line), adjust or replace pulley rim.

8. Tighten pulley rim mounting screws to 11 N·m (100 inch-pounds) torque and lock screw heads in place by bending special lock washers (Fig. 21), similar to original crimp and lock bends on washers.

9. Reinstall Clutch Plate and Hub assembly as described in "R-4 Compressor Clutch Plate and Hub" Replacement procedures.

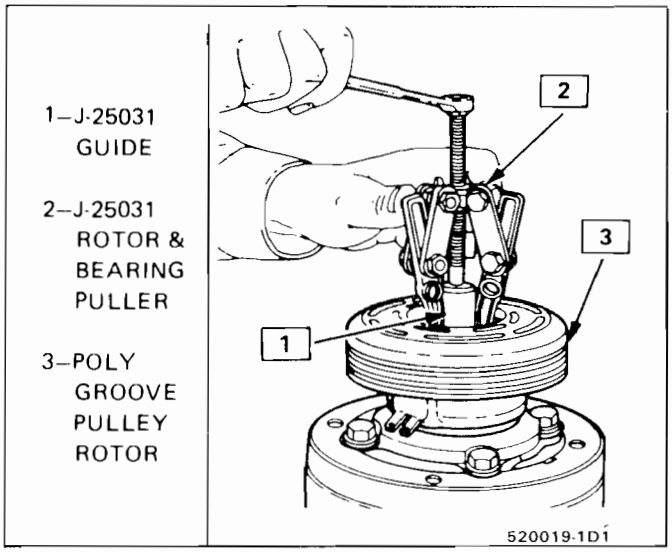


Fig. 20 Removing Clutch Rotor Asm. - Poly-Groove Drive

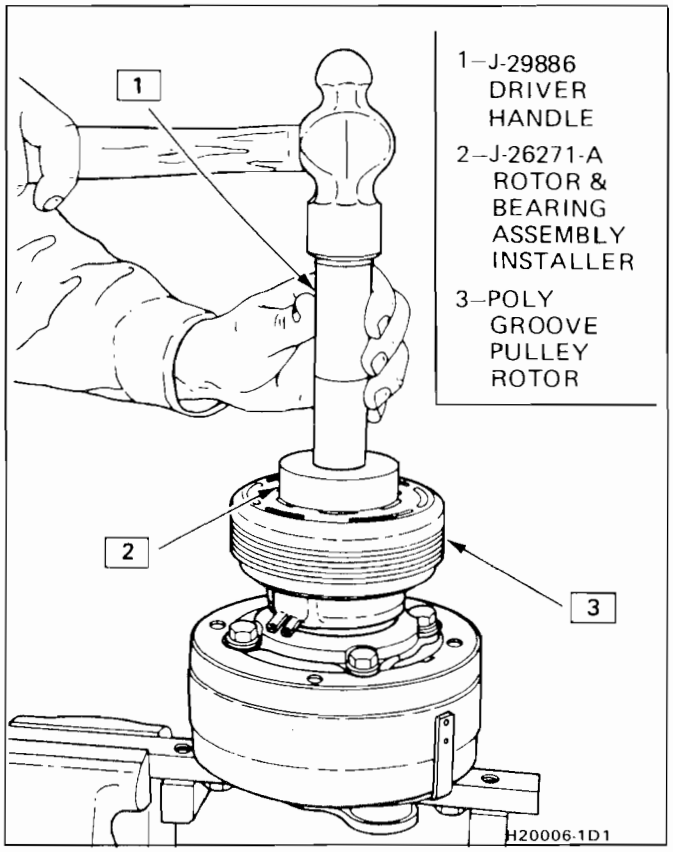


Fig. 21 Installing Rotor & Bearing Assembly, Poly-Groove Type (On Bench)

CLUTCH ROTOR AND/OR BEARING - POLY GROOVE PULLEY - SIX-POLE CLUTCH

Remove or Disconnect

1. Remove the clutch plate hub assembly as previously described.
2. Remove rotor and bearing assembly retaining ring using Snap Ring Pliers J-6083 (Fig. 12).
3. Install Pulley Rotor and Puller Guide J-25031 to the front head (Figure 20) and install J-33020 Pulley Rotor and Bearing Puller down into the inner circle of slots in the rotor (Figure 22). Turn the J-33020 puller clockwise in the slots to engage the puller tangs with the segments between the slots in the rotor (Figure 23).

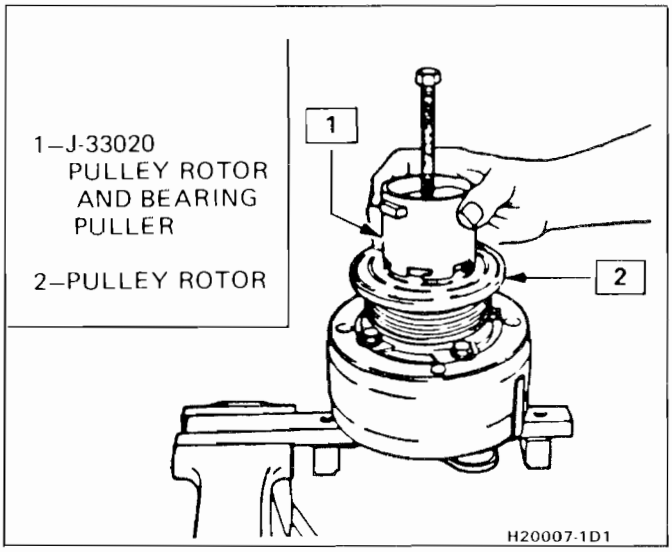


Fig. 22 Pulley Rotor and Bearing Puller Installation

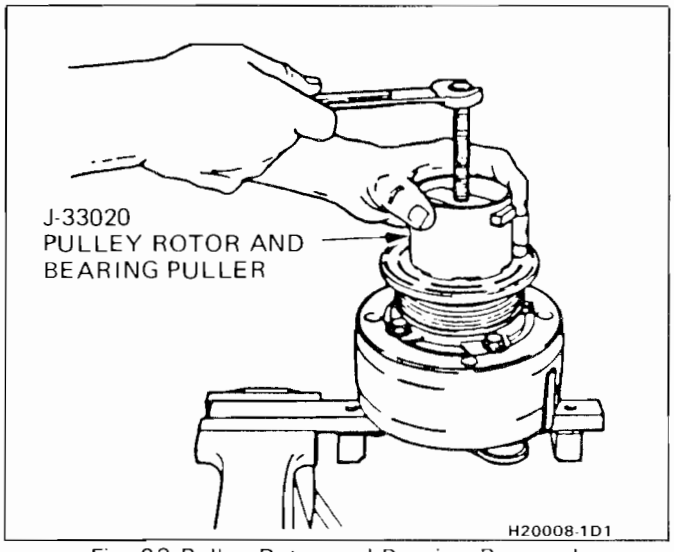


Fig. 23 Pulley Rotor and Bearing Removal

4. Hold the J-33020 Puller in place and tighten the puller screw against the Puller Guide to remove the pulley rotor and bearing assembly.
5. To prevent damage to the pulley rotor during bearing removal, the rotor hub must be properly supported.

   Remove the forcing screw from J-33020 Puller and with the puller tangs still engage in the rotor slots, invert the assembly onto a solid flat surface or blocks as shown in Figure 24.

   6. Drive the bearing out of the rotor hub with Rotor Bearing Remover J-9398-A and J-29886 Universal Handle (Figure 24).

   It is not necessary to remove the staking in front of the bearing, however, it will be necessary to file away the old stake metal (see Fig. 15) for proper clearance for the new bearing to be install into the rotor bore or the bearing may be damaged.

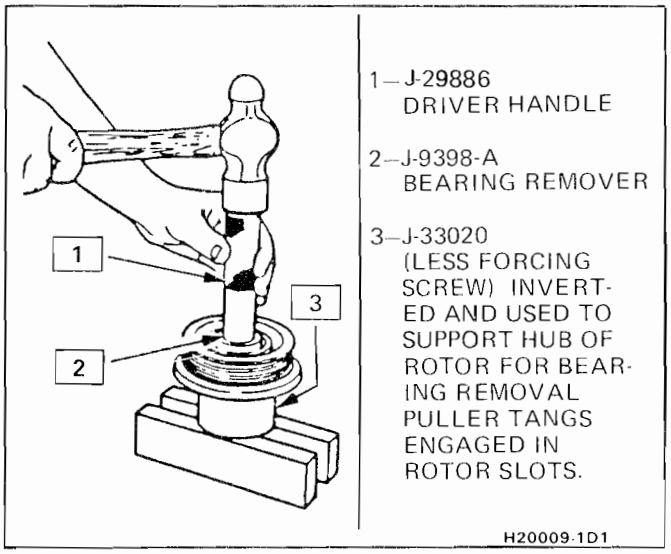


Fig. 24 Bearing Removal

Install or Connect

1. Place the Pulley Rotor on the J-21352-A Support Block to fully support the rotor hub during bearing installation (Figure 25). **Do not** support the rotor by resting the pulley rim on a flat surface during the bearing installation or the rotor face will be bent.
2. Align the new bearing squarely with the hub bore and using Puller and Bearing Installer J-9481-A with with Universal Handle J-29886, drive the bearing fully into the hub (Figure 25). The Installer will apply force to the outer race of the bearing is used as shown.

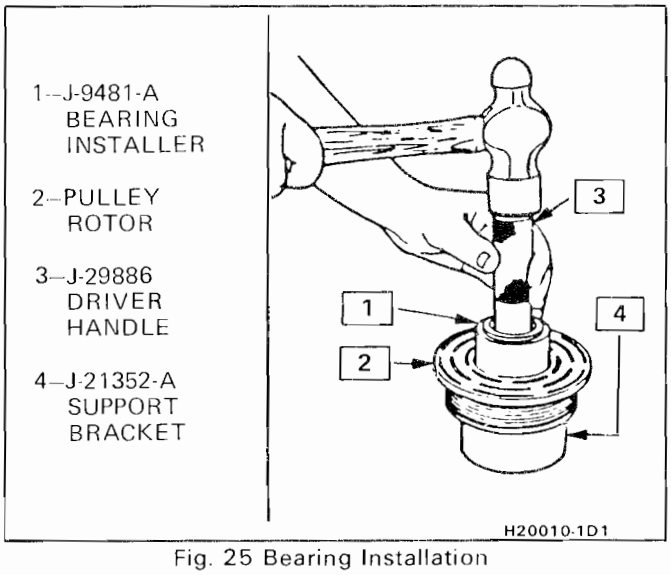


Fig. 25 Bearing Installation

3. Place Bearing Staking Guide J-33019-1 and Bearing Staking Pin J-33019-2 in the hub bore as shown in Figure 26. Shift the rotor and bearing assembly on the J-21352-A Support Block to give full support of the hub under the staking pin location. A heavy duty rubber band may be used to hold the stake pin in the guide Figure 26, and the stake pin should be properly position in the guide after each impact on the pin.

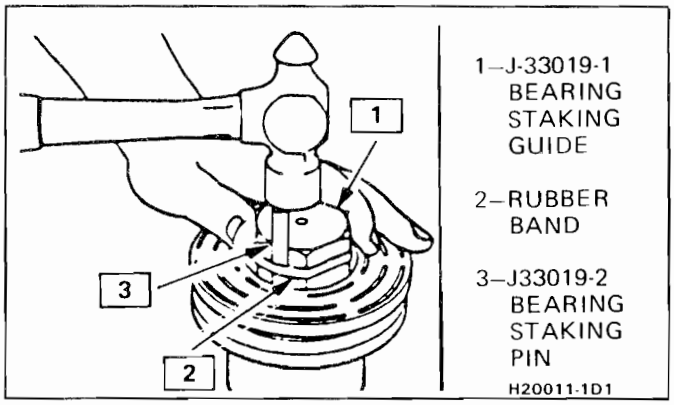


Fig. 26 Bearing Staking

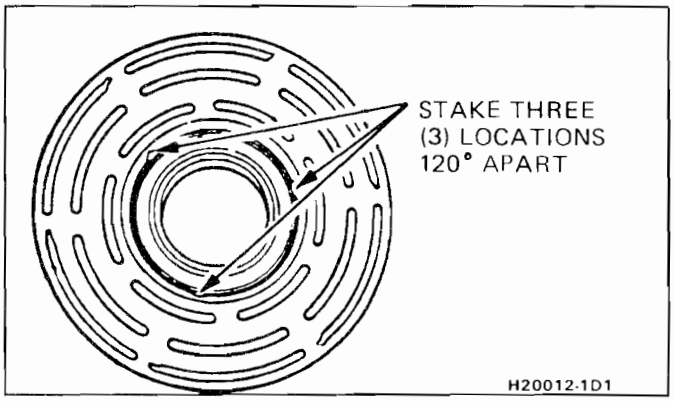


Fig. 27 Staking Location

4. Using care to prevent personal injury, strike the staking pin with a hammer until a metal stake, similar to the original, is formed down to, but not touching, the bearing. Stake three (3) places 120 degrees apart as shown in Figure 27.

   NOTICE: The stake metal should not contact the outer race of the bearing to prevent the possibility of distorting the outer race.

5. With the compressor mounted to the J-25008-A Holding Fixture, position the Rotor and Bearing Assembly on the front head (Figure 28). Using Rotor and Bearing Installer J-9481-A and Universal Handle J-29886 drive the rotor and bearing assembly onto the front head. With the Installer assembled to the Handle as shown (Figure 28), force will be applied to the inner race of the bearing when installing the assembly onto the front head of the compressor.
6. Install rotor and bearing assembly retainer ring, using Snap Ring Pliers J-6083 (Figure 12).
7. Reinstall clutch plate and hub assembly as described previously.

R-4 COMPRESSOR CLUTCH COIL AND/OR PULLEY RIM

Clutch coil and pulley rim installation and removal procedures for the six-pole clutch are the same as the four-pole clutch

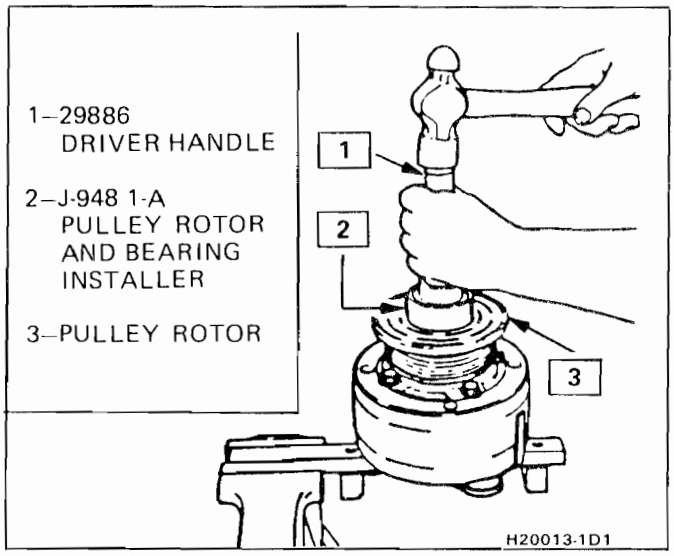


Fig. 28 Pulley Rotor and Bearing Installation

with the exception of Steps 1 through 4 of the clutch rotor and/or bearing - Six-Pole Clutch, removal or disconnect must be used.

V-Groove Drive

Remove or Disconnect

1. Perform Steps 1 through 4 of R-4 COMPRESSOR CLUTCH ROTOR AND/OR BEARING removal procedure but do not loosen or remove the pulley rim mounting screws until the Clutch Rotor, Coil and Pulley Rim assembly have been removed from the Front Head. Be careful not to drop the Puller Guide J-25031 when removing the assembly.
2. Remove the pulley rim mounting screws and special lock washers. Discard the lock washers and screws.
3. Slide the pulley rim off the Rotor and Hub assembly. The Pulley Rim and the Clutch Coil (Fig. 29) are replaceable at this point.

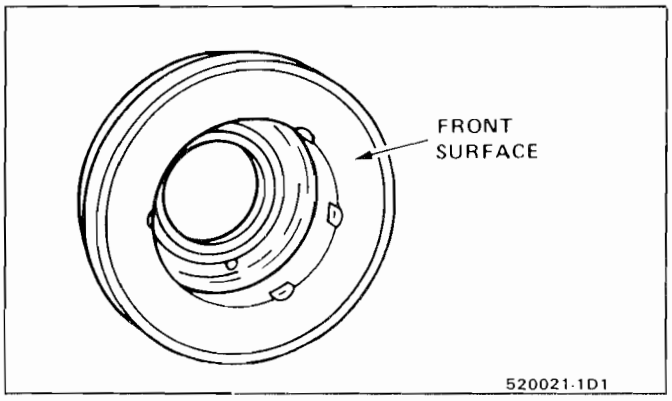


Fig. 29 Clutch Coil Asm.

Poly-Groove Drive

Remove or Disconnect

1. Remove the clutch plate and hub assembly as described previously.
2. Remove the pulley rotor and bearing assembly as described previously. Mark the location of the clutch coil terminals on the compressor.
3. Install Rotor and Bearing Puller Guide J-25031 (Fig. 14) to the front head and install Puller J-8433 with Poly-V-Belt Puller Leg Set J-24092 and remove the clutch coil from the front head (Fig. 30). Clutch coil may also be removed by using rotor and bearing puller guide J-25031 (Fig. 13) with puller tool J-25287 (Fig. 31).

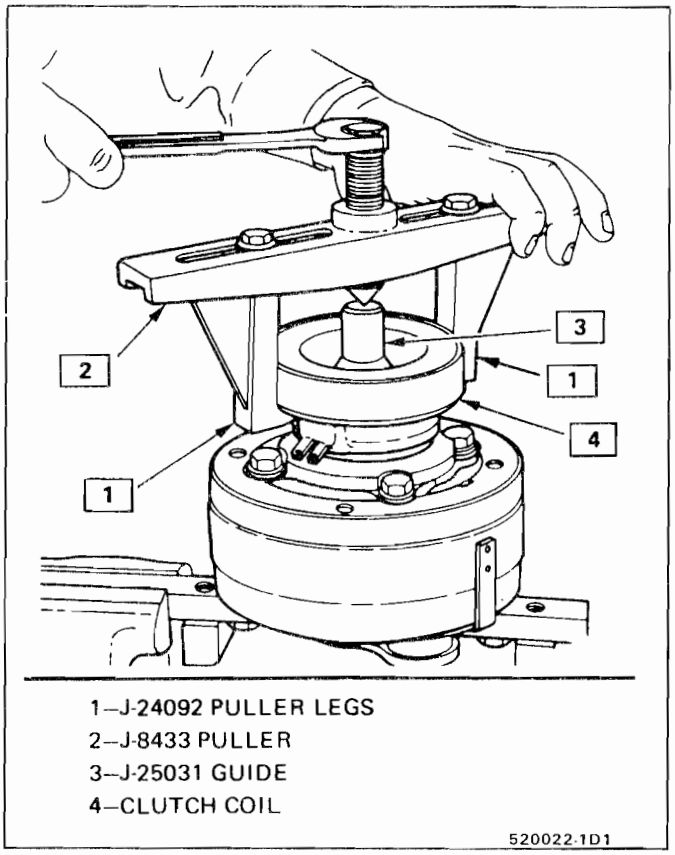


Fig. 30 Removing Poly-Groove Clutch Coil

V-Groove Drive

Install or Connect

1. Assemble the Clutch Coil, Pulley Rim and the Clutch Rotor and Bearing assembly as shown in Fig. 32. Use new screws and special lock washers and apply sealer (Loctite RC-75, Loctite 601, or equivalent) to screw threads but do not lock the screws in place.
2. Place the assembly on the neck of the Front Head and seat into place using Rotor & Bearing Installer J-26271-A (Fig. 18).

   Before fully seating the assembly on the Front Head, be sure the clutch coil terminals are in the proper location in relation to the compressor and that the three protrusions on the rear of the clutch coil align with the locator holes in the Front Head.
3. Install the rotor and bearing assembly retaining ring and reassemble the Clutch Plate and Hub assembly as described in "R-4 Compressor

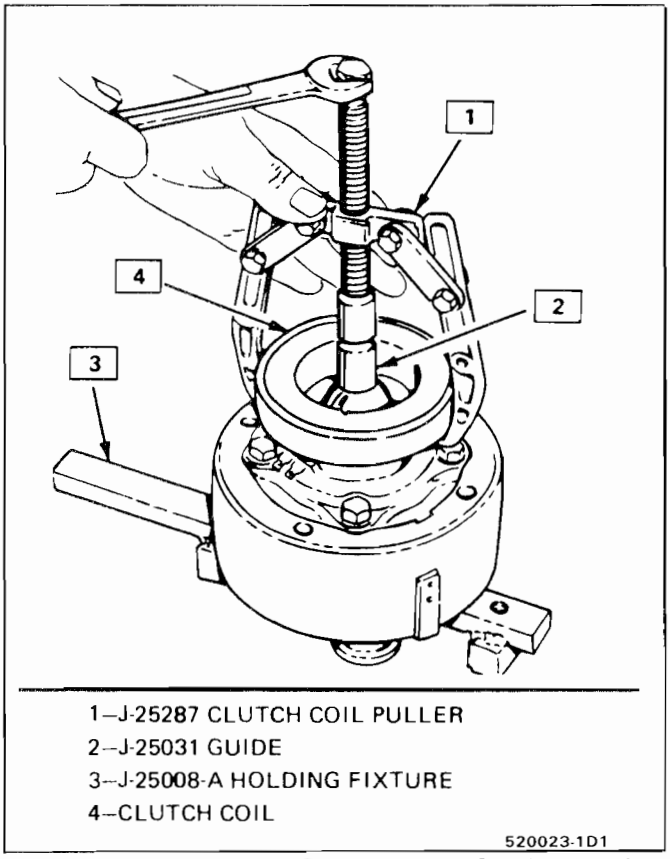


Fig. 31 Removing Poly-Groove Clutch Coil (Optional Method)

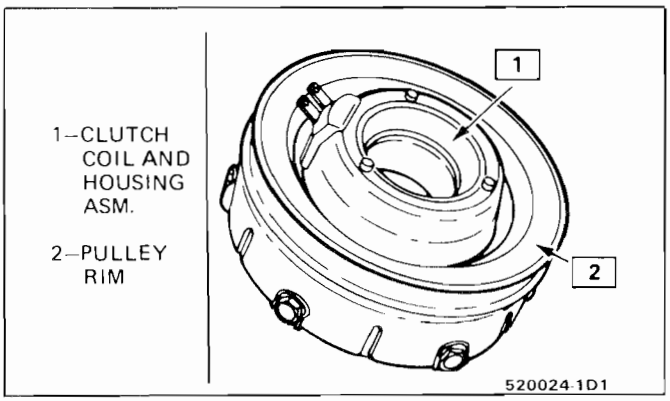


Fig. 32 Assembling Clutch Coil, Pulley Rim, Rotor & Bearing

Clutch Plate and Hub Asm." Replacement procedure. Check to see that the clutch plate to clutch rotor air gap is .5 to 1.0mm (.020 to .040 inches).

Rotate the Pulley Rim and Rotor to be sure the Pulley Rim is rotating "in-line" and adjust or replace as required.

4. Tighten the pulley rim mounting screws to 11 N·m (100 inch-pounds) torque and lock the screw heads in place by bending lock washers similar to original crimp and lock bends on washers.

Install or Connect

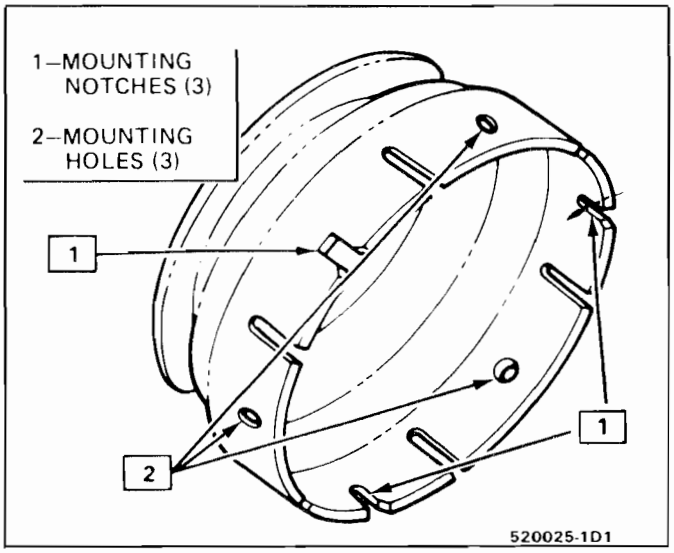


Fig. 33 Pulley Rim Mounting Location Detail

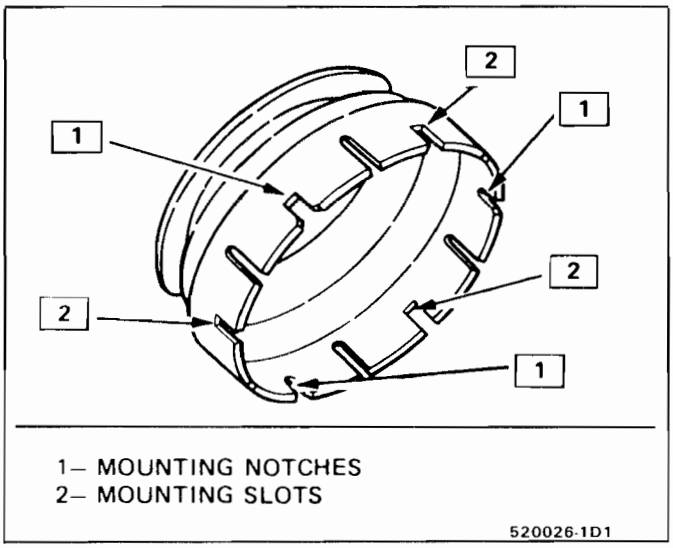


Fig. 34 Pulley Rim Mounting Location Detail - Optional Design

Poly-Groove Drive

1. Place the clutch coil assembly on the neck of the front head with clutch coil terminals in line with mark scribed in Step 2 of the removal procedure.
2. Place the pulley rotor and bearing assembly on the neck of the front head and seat the clutch coil and pulley rotor in place using Rotor and Bearing Installer J-26271-A (Fig. 18).

   Before fully seating the assembly on the front head, be sure the clutch coil terminals are in proper location in relation to the compressor and that the three protrusions on the rear of the clutch coil housing align with the locator holes in the front head.
3. Install the pulley-rotor and bearing assembly retaining ring and reassemble the clutch plate and hub assembly as described in "Clutch Plate and Hub Assembly - Replace."
4. Check to see that the clutch plate to clutch rotor air gap is 0.5 - 1.0mm (0.020" - 0.040").

MAJOR REPAIR PROCEDURES, R-4 COMPRESSOR

Service repair procedures to the Compressor Shaft Seal, Pressure Relief Valve or disassembly of the Internal Compressor Cylinder and Shaft Assembly are considered "MAJOR" SINCE THE REFRIGERATION SYSTEM MUST BE DISCHARGED, EVACUATED AND RECHARGED to complete service and/or because major internal operating and sealing components of the compressor are being disassembled and serviced.

When replacing the shaft seal assembly (see Fig. 34) or pressure relief valve (see Fig. 5), even if the compressor remains on the vehicle during the operation, it will be necessary to purge the system of refrigerant (see Section 1B). Other than clutch repair procedures, the same holds true for any disassembly of the compressor.

If the compressor shell, front head or cylinder and shaft assembly are to be serviced or replaced, the oil in the compressor must be drained, measured and replaced (see Section 1B) to determine addition of proper oil quantity to new assembly.

A clean workbench, preferably covered with a sheet of clean paper, orderliness in the work area and a place for all parts being removed and replaced is of great importance, as is the use of the proper, clean service tools.

NOTICE: Any attempt to use make-shift or inadequate equipment may result in damage and/or improper compressor operation.

All parts required for servicing the internal compressor are protected by a preservation process and packaged in a manner which will eliminate the necessity of cleaning, washing or flushing of the parts. The parts can be used in the internal assembly just as they are removed from the service package. *Seals and protective packaging should be left intact until just prior to installation.*

R-4 COMPRESSOR SHAFT SEAL

Shaft Seal Design

The shaft seal is a one piece design.

Seal Leak Detection

A shaft seal should not be changed because of an oil-line on the hood insulator. The Seal is designed to seep some oil for lubrication purposes. Only change a Shaft Seal when a leak is detected by evidence of oil sprayed in large amounts and then only after actual refrigerant leakage is found by using an approved leak Detector such as J-29547 or equivalent.

Should an R-4 compressor shaft seal ever have to be replaced, the accumulator in this R-4 system must also be removed from the vehicle. The oil in the accumulator then must be drained, measured and replaced according to the directions in Section 1B to determine oil loss.

On-Car

Remove or Disconnect

1. "Discharge the Refrigerant System" according to the direction in Section 1B.
2. Loosen and reposition compressor in mounting brackets, if necessary.
3. Remove Clutch Plate and Hub assembly from compressor as described in Minor Repairs.
4. Remove the shaft seal seat retainer ring, using Snap Ring Pliers J-5403-A.
5. Thoroughly clean inside of compressor neck area and O-ring groove surrounding the shaft, the exposed portion of the seal seat and the shaft itself. Any dirt or foreign material getting into compressor may cause damage.
6. Remove Lip Seal:
   - Fully engage the knurled tangs of Seal Remover-Installer J-23128-A into the recessed portion of the Seal by turning the handle clockwise. Remove the Seal from the compressor with a rotary-pulling motion. Discard the Seal. The handle must be hand-tightened securely. Do not use a wrench or prier. See Fig. 35.
7. Remove and discard the seal seat O-ring from the compressor, neck using O-Ring Remover J-9553-01.
8. Recheck the shaft and inside of the compressor neck and O-ring groove for dirt or foreign material and be sure these areas are perfectly clean before installing new parts.

Inspection

Seals should not be reused. Always use a new specification service seal kit on rebuild. Care should be taken to prevent damage to the lip of the one piece seal. Make sure that the Seal Seat and Seal Lip are free of lint and dirt that could damage the seal surface or prevent sealing.

On-Car

Install or Connect

1. Dip the new seal O-ring in clean 525 viscosity refrigerant oil and assemble onto O-Ring Installer J-33011 (Fig. 36).
2. Insert the O-Ring Installer J-33011 completely down into the compressor neck until the Installer "bottoms." Lower the moveable slide of the O-Ring Installer to release the O-Ring into the seal seat O-ring lower groove. (The compressor neck top groove is for the shaft seal retainer ring.) Rotate the Installer to seat the O-ring and remove the Installer.
3. Prepare Lip Seal:
   - Assemble seal to Seal Installer J-23128-A, by turning handle clockwise, and then push Seal Protector J-34614, into seal lip. The stamped steel case side of the lip seal must be engaged with knurled tangs of installer so

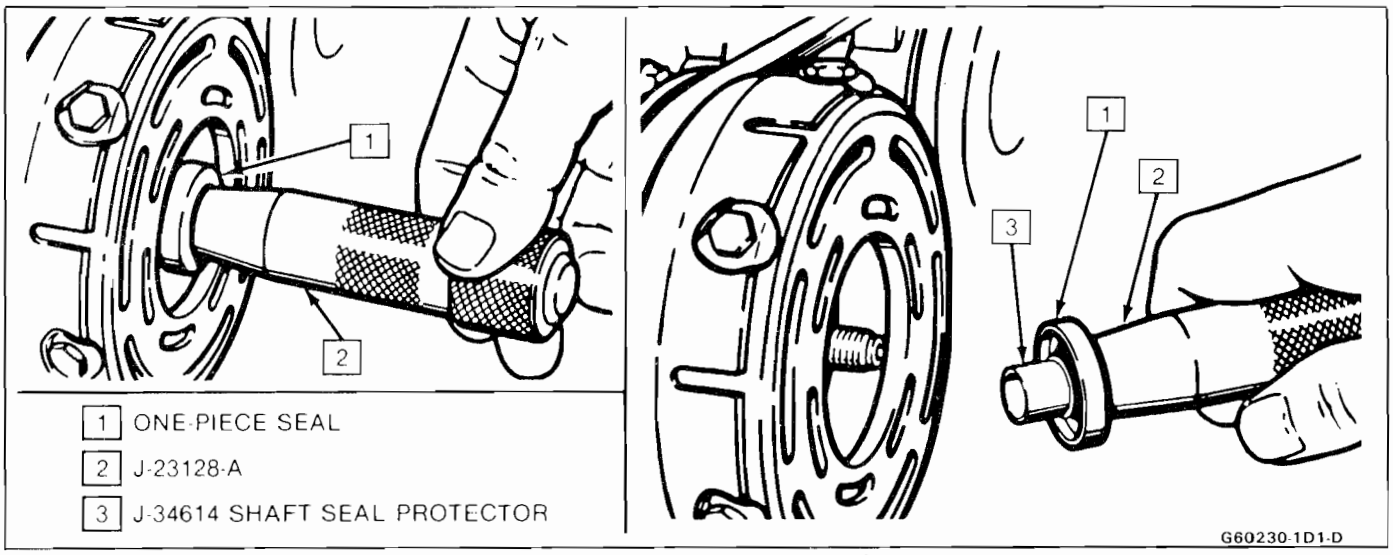


Fig. 35 Removing and Installing Seal

that flared-out side of lip seal is facing and installed towards the compressor.

4. Install Lip Seal:
   - Place seal protector J-34614 over end of compressor shaft and slide new seal onto the shaft until it stops. Disengage in

NOTICE: HANDLING AND CARE OF SEAL PROTECTOR IS IMPORTANT. IF SEAL PROTECTOR IS NICKED OR THE BOTTOM FLARED, THE NEW SEAL MAY BE DAMAGED DURING INSTALLATION.

5. Install the new seal seat retainer ring with its flat side against the Seal Seat, using Snap-Ring Pliers J-5403. See Fig. 38. Use the sleeve from O-Ring Installer J-33011 to press in on the seal seat retainer ring so that it snaps into its groove.
6. For Leak Test, pressurize suction side (low-pressure side) of compressor on vehicle with Refrigerant-12 vapor to equalize pressure to the drum pressure. Temporarily install the shaft nut and, with compressor in horizontal position, rotate the compressor shaft in normal direction of rotation several times by hand. Leak test the Seal and correct any leak found. Remove, discard and later replace the shaft nut.
7. Remove any excess oil, resulting from installing the new seal parts, from the shaft and inside the compressor neck.
8. Install the Clutch Plate and Hub assembly as described in minor repair procedures.
9. Reinstall compressor belt and tighten bracketry.
10. Evacuate and Charge the Refrigerant System according to directions in Section 1B.

Off-Car

Install or Connect

1. Follow applicable on-car procedures.
2. To Leak Test, install leak Test Fixture J-9625 (Fig. 41) on rear head of compressor and connect gage charging lines, or pressurize suction side (low pressure side) of compressor on car with Refrigerant-12 vapor to equalize pressure to the drum pressure. Temporarily install the shaft nut and, with compressor in horizontal position and using a wrench, rotate the compressor shaft in normal direction of rotation several times by hand. Leak test the seal and correct any leak found. Remove, discard and later replace with a new shaft nut.
3. See Figs. 39 and 40.

R-4 COMPRESSOR PRESSURE RELIEF VALVE

The Pressure Relief Valve, located in the compressor rear head casting (Fig. 5), should only be replaced after purging the system of refrigerant. A new valve and O-ring coated with 525 viscosity refrigerant oil should be installed.

HI-SIDE HIGH PRESSURE CUT-OFF SWITCH (IF USED)

Remove or Disconnect

1. Discharge the refrigerant system according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR A/C SYSTEMS in the Air Conditioning Section 1B.
2. Disconnect the electrical connector from the Hi Pressure cut-off switch in the rear head of the compressor (Fig. 42).
3. Remove the high pressure cut-off switch retaining ring (Fig. 42) using J-5403-A internal snap ring pliers. front head mounting screws to 27 N·m (20 lb.ft.) torque.
4. Remove high pressure cut-off switch from compressor by pulling on terminal housing.
5. Remove old O-ring seal from switch cavity using J-9553-01 O-ring removal tool or equivalent.

   If high pressure cut-off switch will be reinstalled in compressor, a new O-ring seal must be used and preferably a new retainer ring should also be

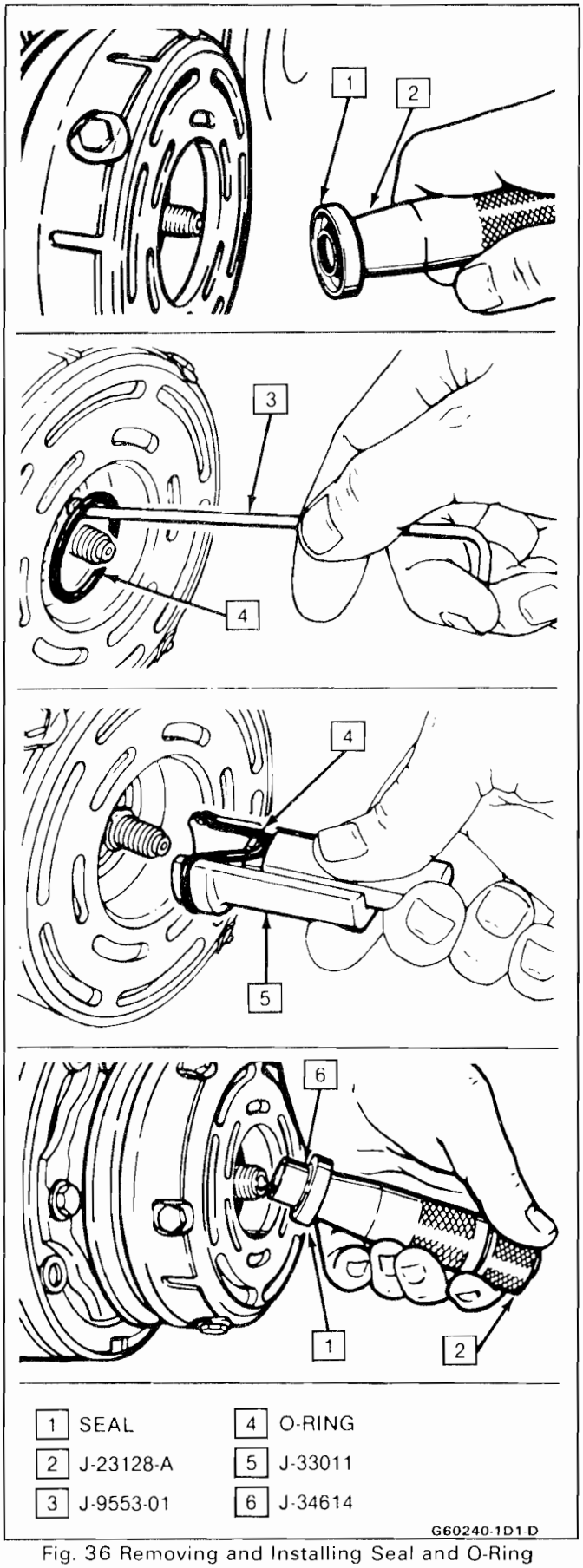


Fig. 36 Removing and Installing Seal and O-Ring

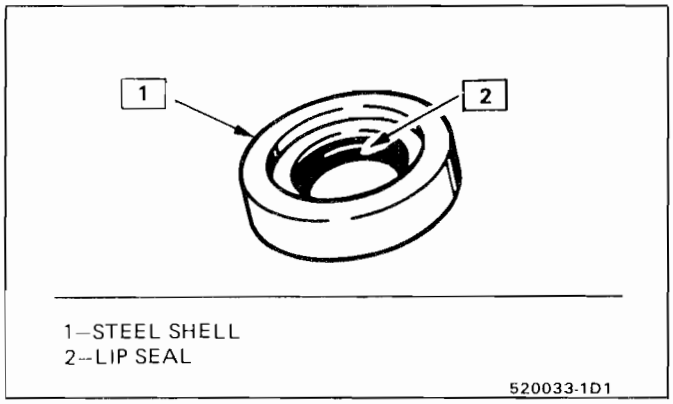


Fig. 37 One Piece Shaft Seal

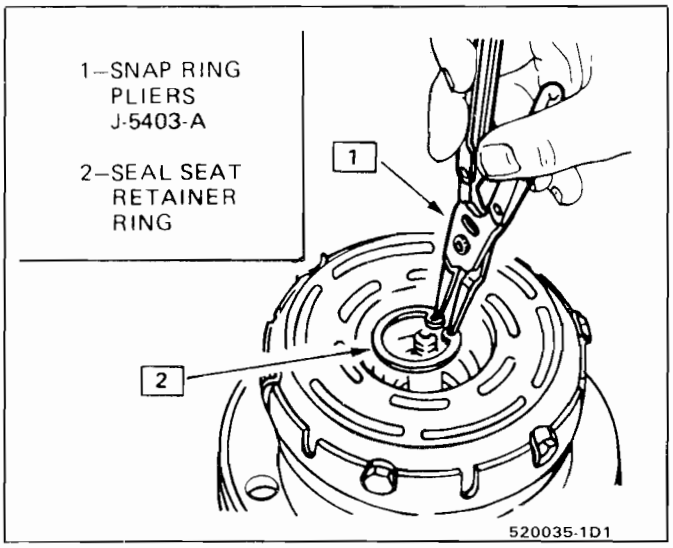


Fig. 38 Removing and Installing Shaft Seal Seat Retaining Ring

used. A new switch kit has the O-ring and retainer ring included.

Install or Connect

1. Check switch cavity and O-ring groove in the rear head for dirt or foreign material and clean as necessary. Install new O-ring coated with clean 525 viscosity refrigerant oil into groove in switch cavity.
2. Lubricate the high pressure cut-off switch housing with clean 525 viscosity refrigerant oil and carefully insert switch into switch cavity until switch bottoms in cavity.
3. Using J-5403-A snap ring pliers, install switch retaining ring with high point of curved sides adjacent to the switch housing. Be sure retaining ring is properly seated in the switch cavity retainer ring groove.

R-4 COMPRESSOR FRONT HEAD AND/OR O-RING

Remove or Disconnect

1. Discharge the Refrigerant System according to the directions in Section 1B.
2. Perform steps 1 through 4 of R-4 COMPRESSOR CLUTCH ROTOR AND/OR

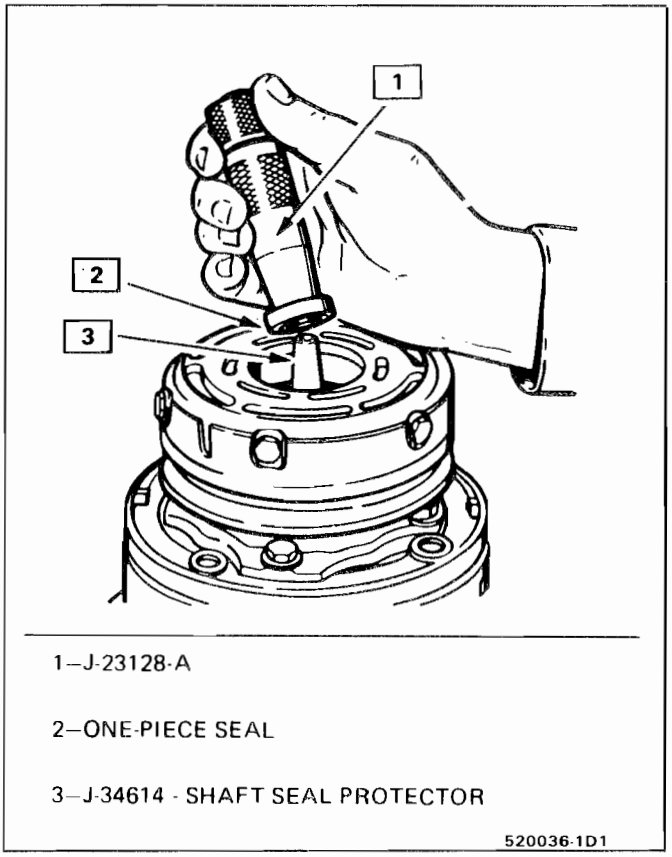


Fig. 39 Removing & Installing One Piece Seal (Off Car)

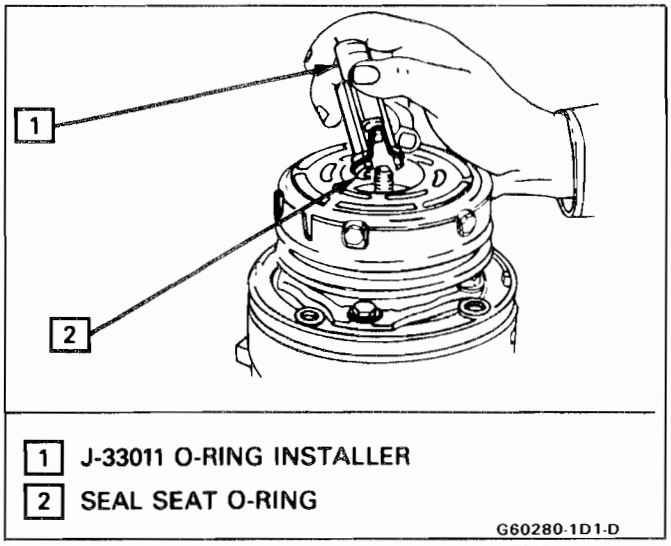


Fig. 40 Installing Seal Seat O-Ring (Off Car)

BEARING removal procedure, but do not loosen or remove the pulley rim mounting screws so as to remove the Clutch Rotor and Bearing, Clutch Coil and Pulley Rim as a total assembly. Be careful not to drop the Puller Guide J-25031 when removing the assembly.

3. Remove and discard the Shaft Seal parts as described in R-4 COMPRESSOR SHAFT SEAL removal procedure.

4. Before removing front head, mark the cylinder next to the narrow front head leg position.

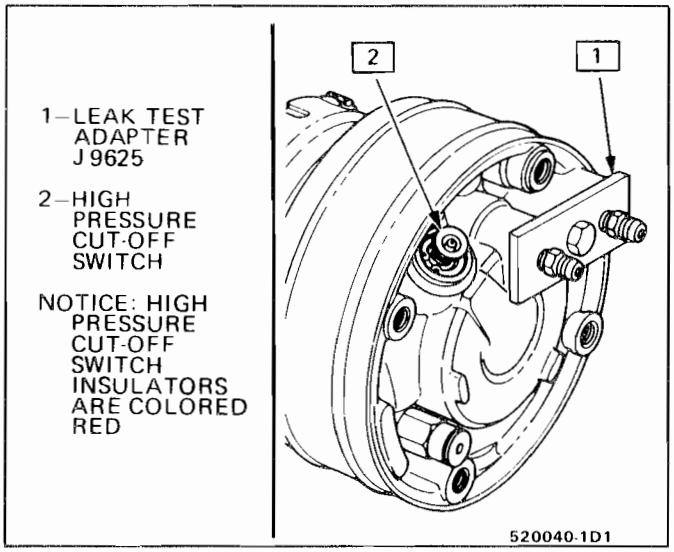


Fig. 41 Compressor Leak Testing Fixture

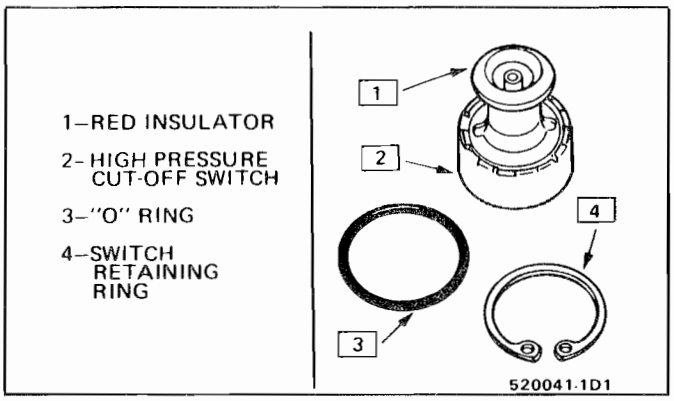


Fig. 42 High Pressure Cut-Off Switch and Retainer

5. Remove the four front head mounting screws (Fig. 43) and remove the Front Head assembly (Fig. 44).

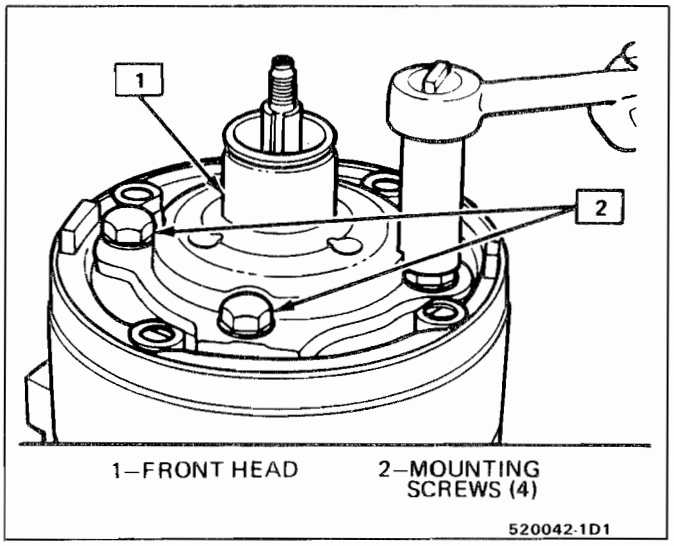


Fig. 43 Removing Front Head Mounting Screws

6. Remove and discard the front head O-ring.

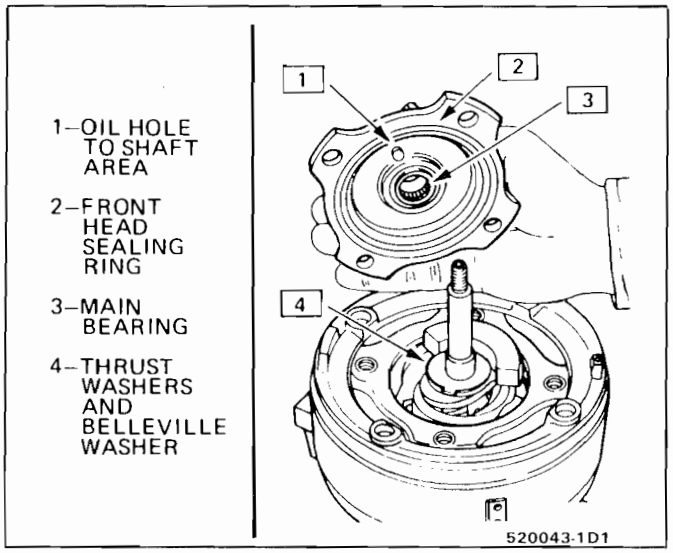


Fig. 44 Removing Front Head Assembly

Install or Connect

1. Check the Front Head and compressor cylinder area for any dirt, lint, etc. and clean if necessary. Install a new Service thrust washer kit, if required, as described in R-4 COMPRESSOR THRUST AND BELLEVILLE WASHERS REMOVAL AND REPLACEMENT procedures.
2. Dip the new front head O-ring in clean 525 viscosity refrigerant oil and install in the seal groove on the front head (Fig. 44).
3. Position the Front Head narrow leg, to the marking previously made on cylinder, and tighten the front head mounting screws to 27 N·m (20 lb. ft.) torque.
4. Install new specification Service Shaft Seal kit as described in R-4 COMPRESSOR SHAFT SEAL REPLACEMENT PROCEDURE.
5. Install the Clutch Rotor and Bearing assembly, Clutch Coil and Pulley Rim assembly to the Front Head, using Rotor and Bearing Installer J-26271-A (Fig. 19).

   Before fully seating the assembly onto the Front Head, be sure the clutch coil terminals are in the proper location in relation to the compressor and that the three protrusions on the rear of the clutch coil align with the locator holes in the Front Head.
6. Install the rotor and bearing assembly retainer ring and reassemble the Clutch Plate and Hub assembly as described in R-4 COMPRESSOR CLUTCH PLATE AND HUB" replacement procedure. Check to see that the clutch plate to clutch rotor gap is .5 - 1.0mm (.020 - .040 inches).
7. Evacuate and charge the refrigerant system according to the directions in Section 1B.

R-4 COMPRESSOR THRUST AND BELLEVILLE WASHERS

Remove or Disconnect

1. Discharge the refrigerant system according to the directions in Section 1B.
2. Remove the Front Head assembly as described in "Front Head Removal Procedure." Remove and discard the front head O-ring seal.
3. Remove the two thrust washers and one belleville washer from the compressor shaft. Note the assembled position of the washers.

Install or Connect

1. Install a new thrust washer on the compressor shaft with the thrust washer tang pointing "UP" (Fig. 45).

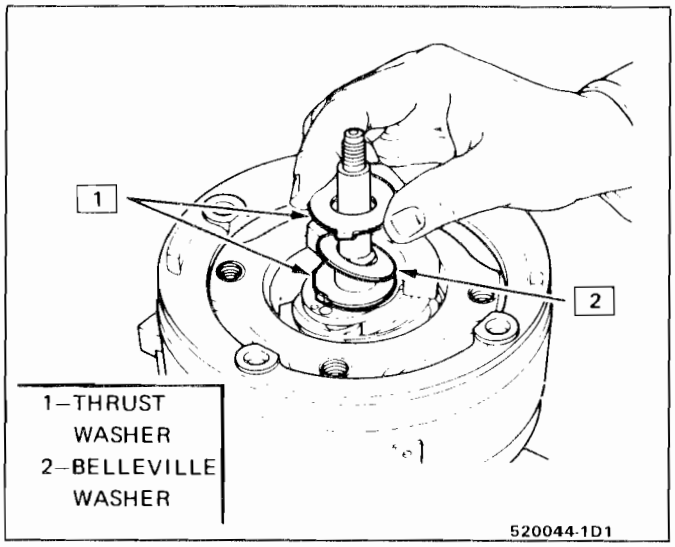


Fig. 45 Replacing Thrust and Belleville Washers

2. Install the new belleville washer on the shaft with the high center of the washer "UP."
3. Install the remaining thrust washer on the shaft with the tang pointing "DOWN" (Fig. 45).
4. Lubricate the three washers with clean 525 viscosity refrigerant oil and assemble the Front Head and new O-ring onto the compressor as described in R-4 COMPRESSOR FRONT HEAD replacement procedure.

R-4 COMPRESSOR MAIN BEARING

Remove or Disconnect

1. Discharge the refrigerant system according to the direction in Section 1B.
2. Remove the Front Head assembly as described in FRONT HEAD REMOVAL PROCEDURE. Discard front head O-ring.
3. Place the Front Head assembly on two blocks, as shown in Fig. 46, and use Main Bearing Remover J-24896 to drive the Main Bearing out of the Front Head.

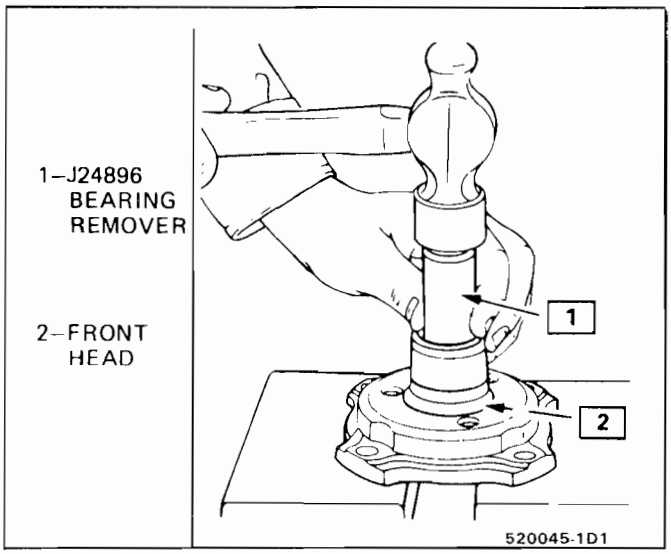


Fig. 46 Removing Main Bearing

Install or Connect

1. Place the Front Head "with neck-end down" on a flat, solid surface.
2. Align the new Main Bearing and the Bearing Installer J-24895 squarely with the bearing bore of the Front Head and drive the bearing into the Front Head. The Installer J-24895 must seat against the Front Head to insert the bearing to the proper clearance depth (see Fig. 47).

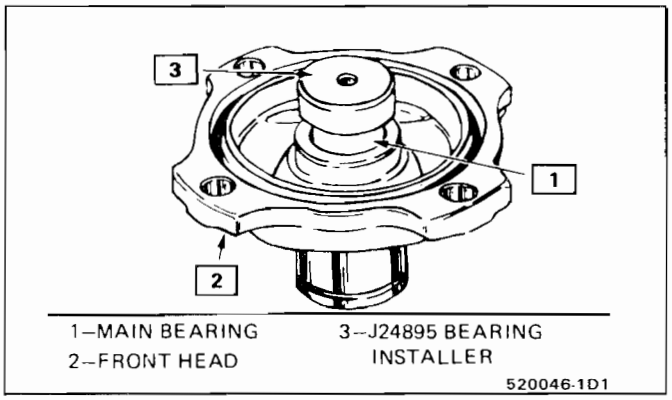


Fig. 47 Installing Main Bearing

3. Assemble the Front Head to the cylinder, using a new O-ring as described in R-4 COMPRESSOR FRONT HEAD replacement procedure.
4. Evacuate and charge the refrigerant system according to the directions in Section 1B.

R-4 COMPRESSOR SHELL AND/OR O-RINGS

Remove or Disconnect

1. Discharge the refrigerant system according to the directions in Section 1B.
2. Thoroughly clean exterior of compressor to prevent dirt from getting into compressor during shell removal.
3. Remove the Clutch Plate and Hub assembly as described in COMPRESSOR CLUTCH PLATE AND HUB removal procedures.
4. Perform Steps 1 through 4 of R-4 COMPRESSOR CLUTCH ROTOR AND/OR BEARING removal procedure but do not loosen or remove the pulley rim mounting screws so as to remove the Clutch Rotor and Bearing, Clutch Coil and Pulley Rim as a total assembly. Be careful not to drop the Puller Guide J-25031 when removing the assembly.
5. Pry the shell retaining strap away from the cylinder and position the strap high enough to clear the cylinder as the Shell is removed (Fig. 48).

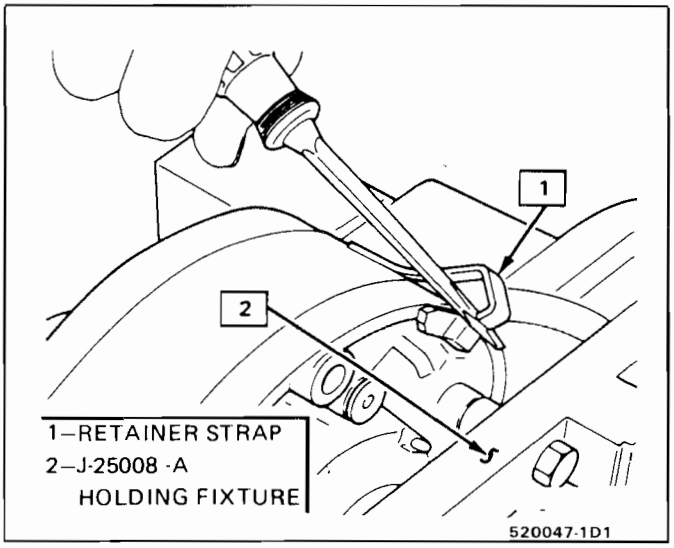


Fig. 48 Releasing Shell Retaining Strap

6. Remove Compressor Holding Fixture J-25008-A, and reverse Holding Fixture with step block protrusions engaging the compressor Shell. Install the medium-length metric thread mounting bolts through the Holding Fixture and thread them finger-tight on both sides into the compressor cylinder until the step of the fixture protrusions contact the compressor Shell (Fig. 48). Check to be sure the step protrusions do not overlap the cylinder but will pass both sides. Allow compressor to cool to room temperature before removing compressor shell.
7. Alternately tighten each bolt approximately 1/4 turn to push the Shell free of the O-rings on the cylinder (Fig. 49).

   If one (1) screw appears to require more force to turn than the other, immediately turn the other screw to bring the screw threading sequence in-step or the Shell will be cocked and made more difficult to remove. Normal removal does not require much force on the wrench if the screws are kept in-step while turning. The Shell can be removed by hand as soon as the Shell is free of the shell to cylinder O-rings. Do not turn the screws any further than necessary to release the Shell.
8. Remove the compressor Shell and remove the Holding Fixture J-25008-A from the compressor.

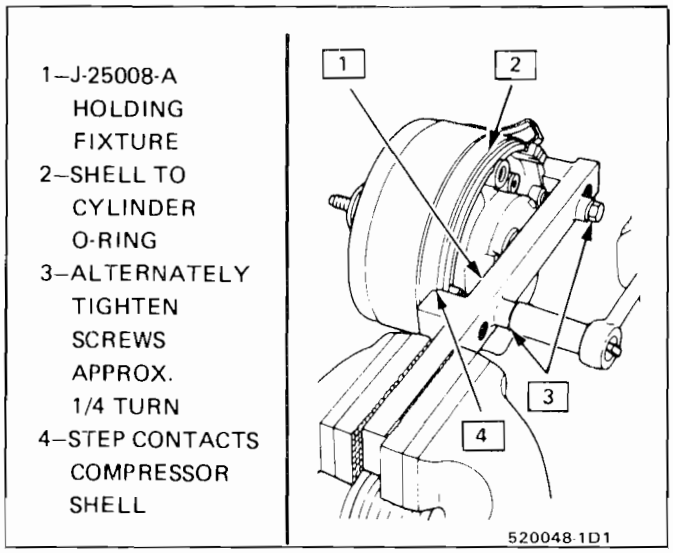


Fig. 49 Removing Shell

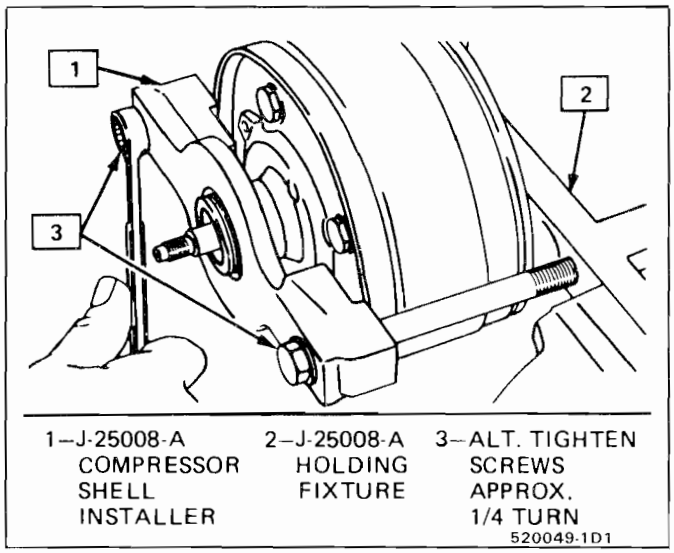


Fig. 50 Installing Shell

Reverse the Holding Fixture to again hold the compressor by the opposite side, using the short-length screws with metric threads.

9. Remove and discard both cylinder to Shell O-rings.

Install or Connect

1. Check the compressor cylinder assembly and interior of the compressor Shell to be sure they are free of lint, dirt, etc.
2. Dip a new cylinder-to-shell O-ring in clean 525 viscosity refrigerant oil and install in the rear O-ring groove of the cylinder. Be careful in moving the O-ring across the cylinder surface to prevent damaging the O-ring.
3. Dip the remaining cylinder-to-shell O-ring in the 525 oil and install it in the front O-ring groove of the cylinder.
4. Also coat inner O-ring surface of compressor Shell with oil. Place the compressor Shell on the cylinder and rotate the retaining strap to its original location.
5. Attach the Shell Installing Fixture J-25008-A to the Holding Fixture J-25008-A, using the long-bolts and plate washers of the set. Align the step projections of the Installing Fixture J-25008-A, to contact the compressor Shell evenly on both sides.
6. Push the compressor shell as close to the O-ring, Fig. 50, as possible by hand and check for equal alignment of the shell around the cylinder. Tighten the Fixture screws finger tight.
7. Alternately tighten each bolt approximately 1/4 turn to push the compressor Shell over the O-rings and back against the shell stop flange at the rear of the compressor cylinder.

   If one (1) screw appears to require more force to turn than the other, immediately turn the other screw to bring the screw threading sequence in-step or the shell will be cocked and made more difficult to install. Normal installation does not require much force on the wrench if the screws are kept in-step while turning.
8. When the shell is seated against the stops, bend the shell retaining strap down into place by tapping gently with a hammer. Remove the Shell Installing Fixture J-25008-A.
9. Reinstall Clutch Rotor and Bearing Asm., Clutch Coil and Pulley Rim as an assembly with Installer J-26271-A (Fig. 19), and the Clutch Plate and Hub Assembly with Installer J-9480-B (Fig. 11).
10. "Evacuate and Charge the Refrigerant System" according to the directions in Section 1B.

R-4 COMPRESSOR DISCHARGE VALVE PLATE AND/OR RETAINER

Remove or Disconnect

1. Discharge the refrigerant system according to the directions in Section 1B.
2. Perform Steps 1 through 9 of R-4 COMPRESSOR SHELL AND/OR O-RINGS removal procedure.
3. Remove valve plate retainer ring, using Internal Snap Ring Pliers J-4245, Fig. 51. Remove Compressor Discharge Valve Plate (Fig. 52) for valve plate replacement and/or piston inspection. Repeat this operation for additional valve plates and retainer rings. If all four valve plates and retainers are to be removed, remove two sets and then rotate compressor and Holding Fixture J-25008-A in vise for access to the remaining two valve plates and retainers.

Install or Connect

1. Install Discharge Valve Plates and/or Retainers as shown in Figs. 51 and 52. Reposition compressor and Holding Fixture in vise as necessary for access. **Valve plates must be tight following retainer assembly.**
2. Reinstall compressor Shell as described in R-4 COMPRESSOR SHELL AND/OR O-RINGS replacement procedures.
3. Evacuate and charge the refrigerant system according to the directions in Section 1B.

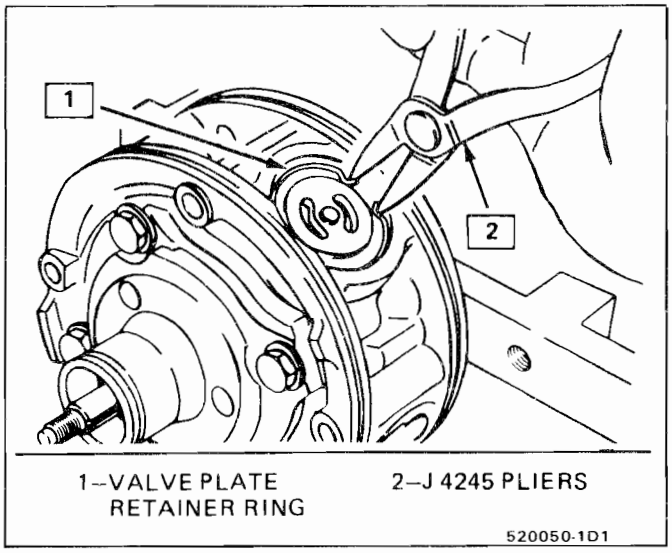


Fig. 51 Replacing Valve Plate Retainer

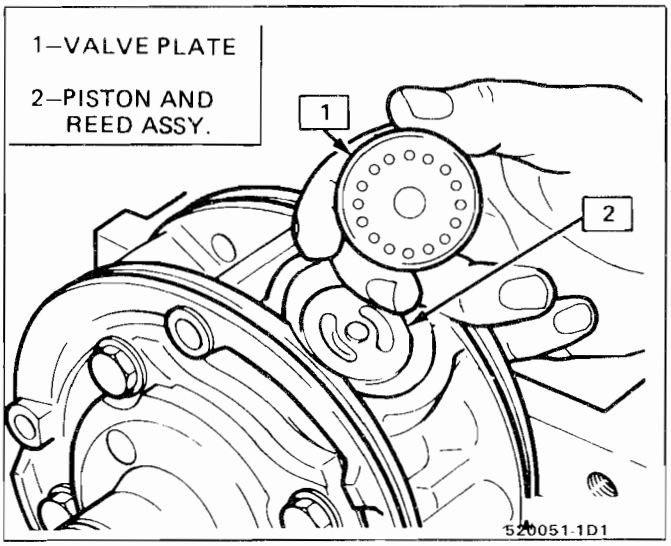


Fig. 52 Replacing Discharge Valve Plate

R-4 COMPRESSOR CYLINDER AND SHAFT ASM.

Remove or Disconnect

1. Discharge the refrigerant system according to the directions in Section 1B.
2. Remove the Clutch Plate and Hub assembly as described in COMPRESSOR CLUTCH PLATE AND HUB removal procedure.
3. Perform Steps 1 through 4 of R-4 COMPRESSOR CLUTCH ROTOR AND/OR BEARING removal procedure but do not loosen or remove the pulley rim mounting screws. Remove the Clutch Rotor and Bearing, Clutch Coil and Pulley Rim as an assembly. Be careful not to drop the Puller Guide J-25031, when removing the assembly.
4. Remove the shaft seal as described in SHAFT SEAL removal procedure.
5. Remove the front head as described in FRONT HEAD REMOVAL procedure.
6. Remove the thrust and belleville washers as described in THRUST AND BELLEVILLE WASHERS removal procedures.
7. Remove the compressor shell as described in SHELL removal procedure.
8. Remove the discharge valve plate and retainer as described in DISCHARGE VALVE PLATE AND/OR RETAINER removal procedure.
9. Remove the high pressure relief valve as described in HIGH PRESSURE RELIEF VALVE REMOVAL PROCEDURE.

Install or Connect

1. Replace above parts in opposite order.
2. Evacuate and charge the refrigerant system according to the directions in Section 1B.

R-4 COMPRESSOR LEAK TESTING (EXTERNAL AND INTERNAL)

Bench-Check Procedure

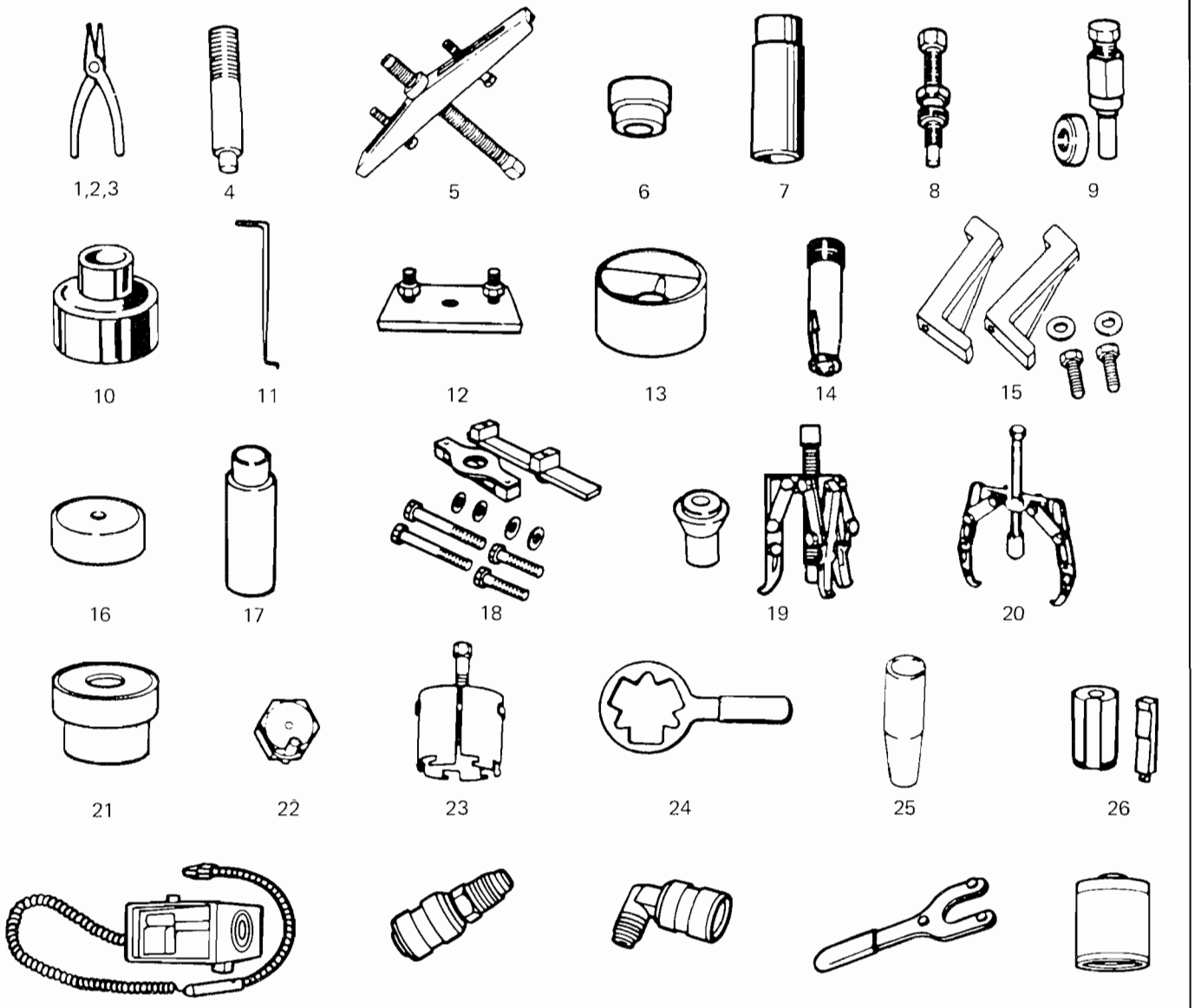
1. Install Test Plate J-9625-A on Rear Head of compressor.
2. Attach center hose of Manifold Gage Set on Charging Station to a refrigerant drum standing in an upright position and open valve on drum.
3. Connect Charging Station high and low pressure lines to corresponding fittings on Test Plate J-9625-A, using J-5420 Gage Adapters if hoses are not equipped with valve depressors.
   - Suction port (low-side) of compressor has large internal opening. Discharge port (hi-side) has smaller internal opening into compressor.
4. Open low-pressure control, high-pressure control and refrigerant control on Charging Station to allow refrigerant vapor to flow into compressor.
5. Using a Leak Detector, check for leaks at Pressure Relief Valve, compressor shell to cylinder, compressor front head seal, and compressor Shaft Seal. After checking, shut off low pressure control and high pressure control on Charging Station.
6. If an external leak is present, perform the necessary corrective measures and recheck for leaks to make certain the leak has been corrected.
7. Loosen the Manifold Gage hose connections to the Gage Adapters J-5420 connected to the low and high sides and allow the vapor pressure to release from the compressor.
8. Disconnect both Gage Adapters J-5420 from the Test Plate J-9625-A.
9. Rotate the complete compressor assembly (not the crankshaft or drive plate hub) slowly several turns to distribute oil to all cylinder and piston areas.
10. Install a shaft nut on the compressor crankshaft if the drive plate and clutch assembly are not installed.
11. Using a box-end wrench or socket and handle, rotate the compressor crankshaft or clutch drive plate on the crankshaft several turns to ensure piston assembly to cylinder wall lubrication.

12. Connect the Charging Station high pressure line or a high pressure gage and Gage Adapter J-5420 to the Test Plate J-9625-A high side connector.
13. Attach an Adapter J-5420 to the suction or low pressure port of the Test Plate J-9625-A to open the Schrader-type valve.

    Oil will drain out of the compressor suction port adapter if the compressor is positioned with the suction port downward.
14. Attach the compressor to the Holding Fixture J-25008-A using metric mounting screws. Clamp the compressor Holding Fixture in a vise so that the compressor can be manually turned with a wrench.
15. Using a wrench, rotate the compressor crankshaft or drive plate hub ten (10) complete revolutions at a speed of approximately one-revolution per second.

    Turning the compressor at less than one-revolution per second can result in a lower pump-up pressure and disqualify a good pumping compressor.
16. Observe the reading on HIGH pressure gage at the completion of the tenth (10th) revolution of the compressor. The pressure reading for a good pumping compressor should be 344.75 kPa (50 p. s.i.) or above. A pressure reading of less than 310. 275 kPa (45 p.s.i.) would indicate one or more suction and/or discharge valves leaking, an internal leak or an inoperative valve, and the compressor should be disassembled and checked for cause of leak. Repair as needed, reassemble and repeat the pump-up test. Externally leak test.
17. When the pressure pump-up test is completed, release the air pressure from the HIGH side and remove the Gage Adapters J-5420 and Test Plate J-9625-A.
18. On the R-4 compressor, tilt the compressor so that the compressor suction and discharge ports are down. Drain the oil from the compressor.
19. Allow the compressor to drain for 10 minutes, then charge with the proper amount of oil. The oil may be poured into the suction port.

    If further assembly or processing is required, a shipping plate or Test Plate J-9625-A should be installed to keep out air, dirt and moisture until the compressor is installed.



1-J-4245	SNAP RING PLIERS (#23 INTERNAL)	18-J-25008-A	COMPRESSOR HOLDING FIXTURE
2-J-5403	SNAP RING PLIERS (#21 INTERNAL)	19-J-25031	ROTOR AND BEARING PULLER WITH GUIDE
3-J-6083	SNAP RING PLIERS (#24 INTERNAL)	20-J-25287	CLUTCH COIL PULLER
4-J-29886	DRIVER HANDLE	21-J-26271-A	ROTOR AND BEARING INSTALLER (WITHOUT HANDLE)
5-J-8433	COMPRESSOR PULLEY PULLER	22-J-33019	BEARING STAKING TOOL
6-J-9398-A	ROTOR BEARING REMOVER	*23-J-33020	PULLEY PULLER
7-J-9399	9/16" THIN WALL SOCKET	24-J-33027	CLUTCH HUB HOLDING TOOL
8-J-33013-B	HUB AND DRIVE PLATE ASSEMBLY REMOVER	25-J-34614	SHAFT SEAL PROTECTOR
9-J-9480-B	HUB AND DRIVE PLATE ASSEMBLY INSTALLER	26-J-33011	SEAL SEAT O-RING INSTALLER
10-J-9481-A	PULLEY BEARING AND PULLEY INSTALLER	27-J-29547	ELECTRONIC LEAK DETECTOR
11-J-9553-01	O-RING REMOVER	28-J-5420	7/16"-20 STRAIGHT ADAPTER
12-J-9625-A	PRESSURE TEST CONNECTOR	28-J-25498	7/16"-20 x 3/8"-24 STRAIGHT ADAPTER
*13-J-21352-A	COMPRESSOR SUPPORT BLOCK	29-J-9459	7/16"-20 90° ELBOW ADAPTER
14-J-23128-A	SEAL REMOVER AND INSTALLER	29-J-25499	7/16"-20 x 3/8"-24 90° ELBOW ADAPTER
15-J-24092	PULLEY HUB ADAPTER SET (USED WITH J-8433)	30-J-25030	CLUTCH HUB HOLDING TOOL
16-J-24895	BEARING INSTALLER (FRONT END)	31-J-33024	CLUTCH COIL INSTALLER ADAPTER
17-J-24896	BEARING REMOVER (FRONT HEAD)		

*Indicates tools used only on the 6 pole clutch

H20020-1D1

Fig. 53 Special Tools, R-4 A/C Compressor Overhaul

SECTION 2B
BUMPERS

NOTICE: Fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts. For prevailing torque (nut(s) and bolt(s), refer to the "Reuse of Prevailing Torque Nuts(s) and Bolt(s)" chart in Section 0A.

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Specifications 2B-5

GENERAL DESCRIPTION

BUMPER SYSTEMS

The bumper system is an extension assembly with the front bumper attached to the front crossmember of the frame-birdcase assembly while the rear bumper is attached to a bolted on aluminum frame extension.

The front bumper (Fig. 2B-1) consists of a full width honeycomb energy absorber, backed by an impact bar of strong continuous glass fiber plastic that is covered by a bolted on facia with fender extensions and made of stabile glass-reinforced RIM. The fascia material can withstand minor impact and return to its original shape. The rear bumper is of similar honeycomb design (see Fig. 2B-4).

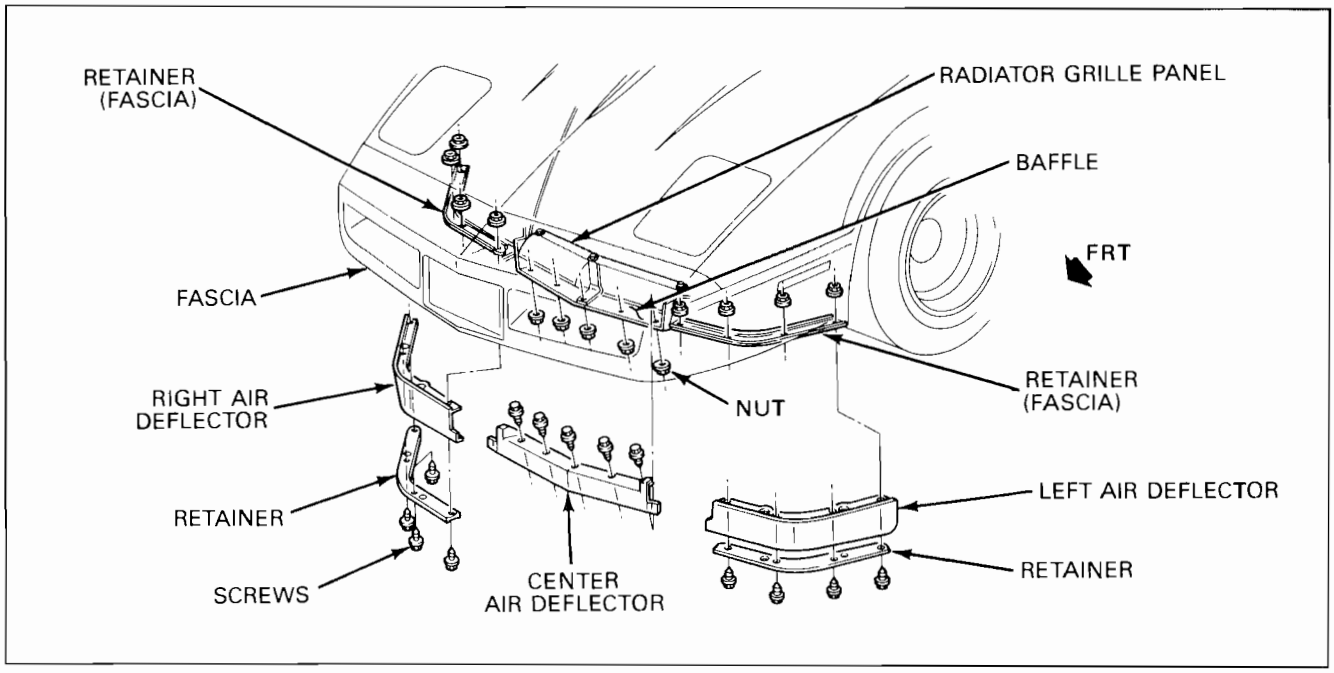


Figure 2B-1--Front Air Deflector

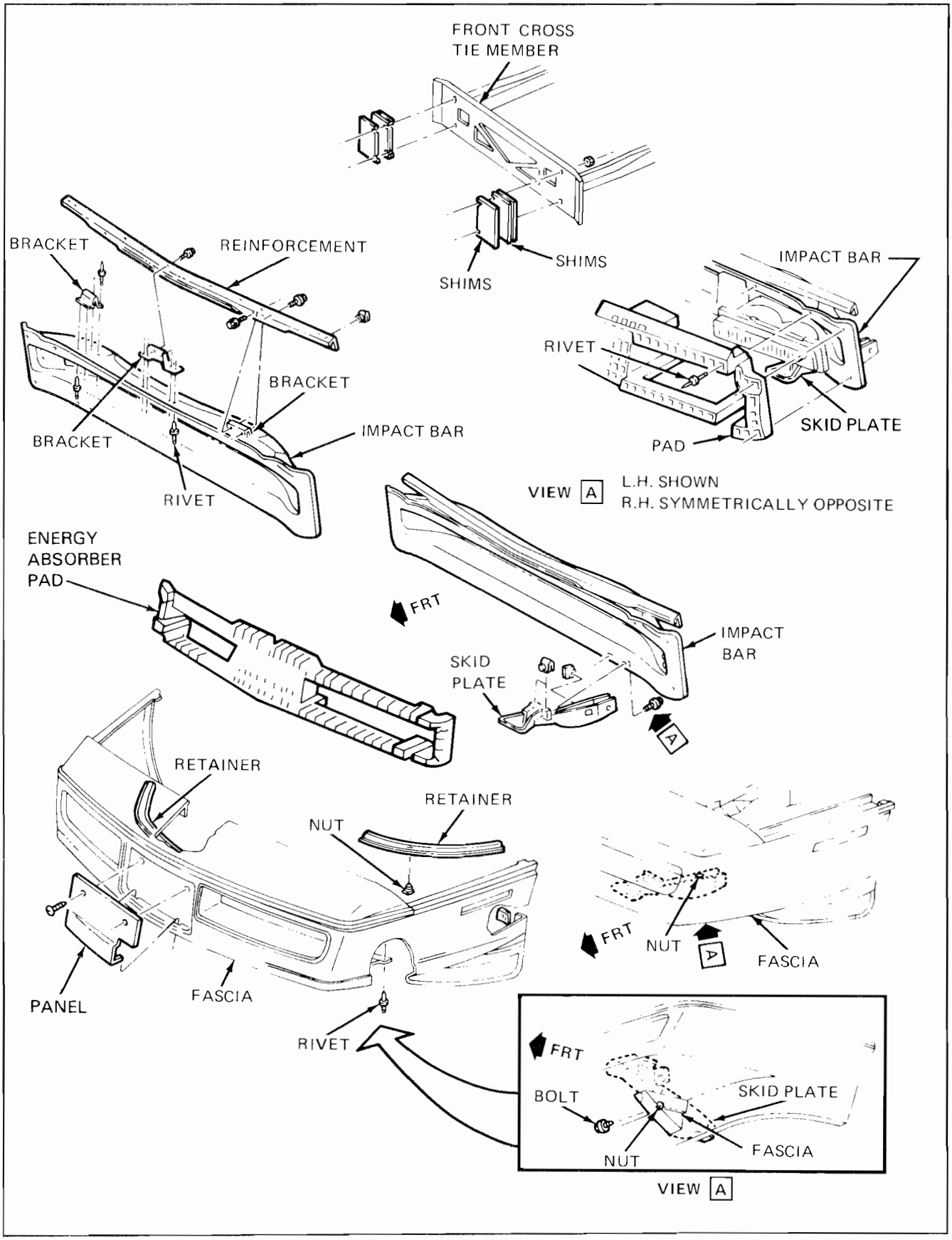


Figure 2B-2--Front Bumper Assembly

ON-CAR SERVICE

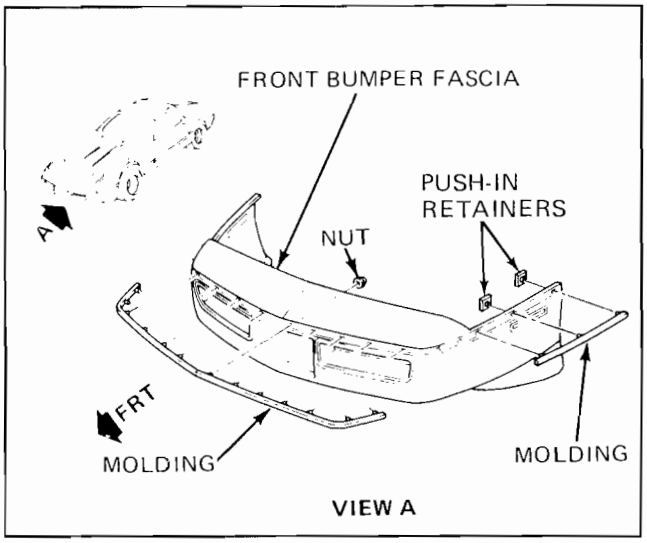


Figure 2B-3--Front Bumper Molding

FRONT BUMPER (FIG. 2B-2)

Removal

1. Raise hood to gain working clearance.
2. Disconnect battery ground cable.
3. Disconnect bulbs from parking lamps and side marker lamps.
4. Remove wheelhouse seal from upper edge of fascia and remove 4 screws each side.
5. Remove 12 screws attaching top of fascia to impact bar reinforcement.
6. Remove 4 screws attaching rear vertical edge to splash shield (each side) and 2 upper inner screws attaching fascia to support.
7. Raise vehicle, remove four screws each side attaching fascia to outer air dams. (Fig. 2B-1).
8. Remove 4 screws attaching fascia to lower edge of impact bar.
9. Remove screws attaching fascia to skid plate.
10. Lower vehicle - remove fascia from vehicle by lifting upper edge of fascia away from reinforcement and at the same time rotating fascia downward. For fascia molding removal and attachment, see Fig. 2B-3.

IMPACT BAR AND ENERGY ABSORBING PAD ASSEMBLY

Removal

To gain access to the left side impact bar to front cross tie member left side attaching nuts, the evaporator control system canister must be removed.

1. Disconnect purge lines at steel pipes and remove canister.
2. Remove four (2 each side) impact bar assembly to front cross tie member attaching nuts.

   NOTICE: Note the number and location of shim packs.
3. Separate the energy absorbing pad from the impact bar by drilling out retaining rivets.

Installation

Reverse removal steps to reinstall impact bar assembly and fascia. Make sure outer 2 pieces of air dam match up with center part.

REAR BUMPER (SEE FIG. 2B-4)

Removal

1. Disconnect battery ground cable.
2. Raise gas filler door and remove 4 gas filler door to body retaining screws.
3. Remove gas cap and remove filler neck overfill seal. Replace gas cap.
4. Remove 3 screws each side attaching fascia to gas door opening panel. Fourth screw can be removed later when working underneath vehicle.
5. Raise vehicle.
6. Remove fascia bottom edge to energy absorbing pad attaching screws, (4).
7. Remove rear wheelhouse panel to lower side fascia attaching screws.
8. Disconnect side marker and backup-cornering lamps.
9. Remove fascia to body (lower-horizontal) attaching nuts (4), two each side.
10. Remove license plate lamp. Disconnect back-up lamps.
11. Remove (2) carriage bolts attaching license plate opening to frame extension (Fig. 2B-4).
12. Pull fascia backward at bottom edge to gain access for removal of upper side fascia to body attaching nuts (10).
13. Disconnect tail lamps.
14. At this point, pull fascia back and remove remaining attaching screws (6) (top fascia to body).
15. Remove fascia from vehicle. If necessary, remove energy absorber pad from frame extension.

    Note: Remove spare wheel lamp before removing energy absorber pad.

Installation

1. Lower vehicle and install fascia to body.
2. Line up holes and install (3) (each side) fuel door opening attaching screws, then reverse removal procedure to complete installation of fascia to body.

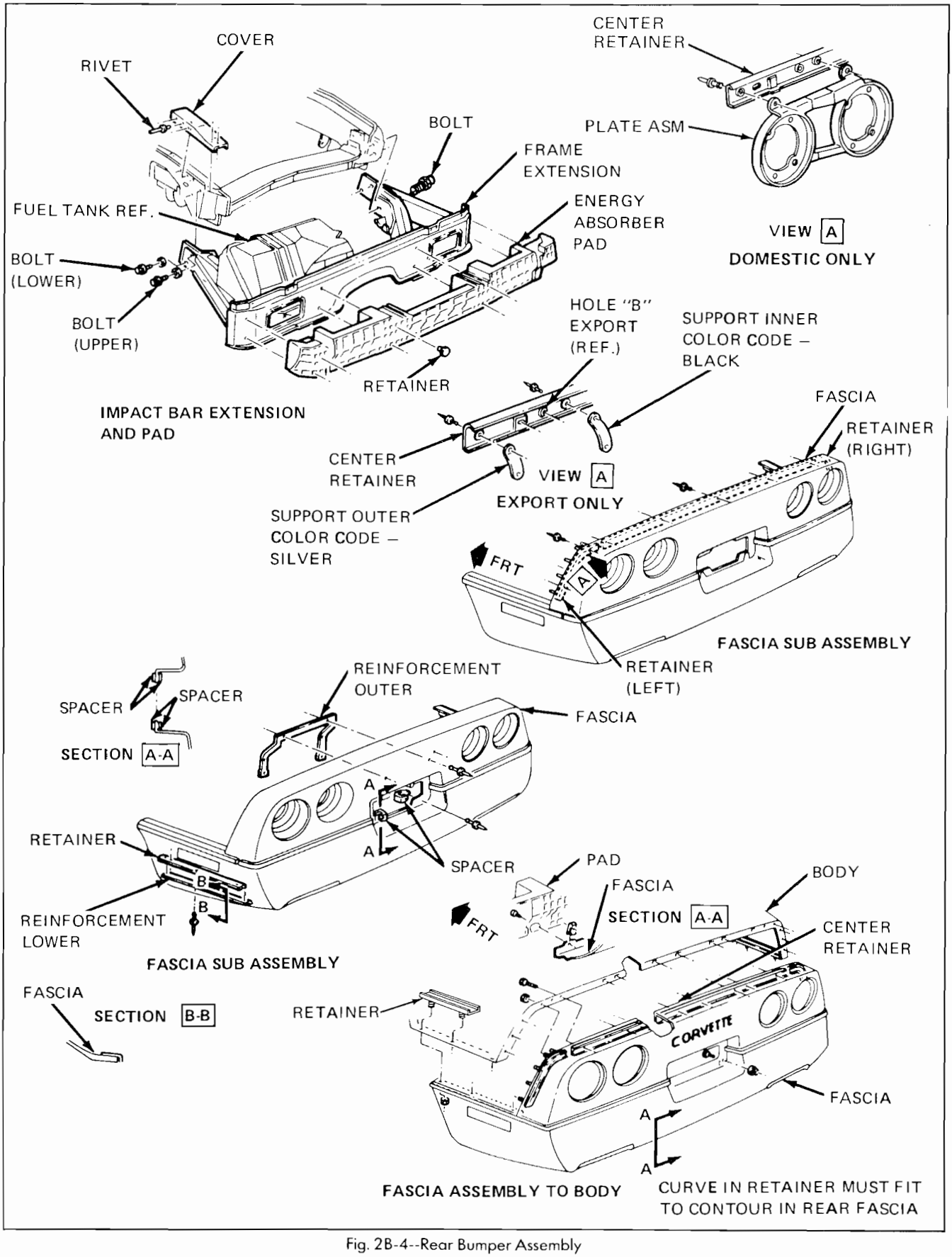


Fig. 2B-4--Rear Bumper Assembly

SPECIFICATIONS

FRONT BUMPER FASTENER TORQUES

Impact Bar to Reinforcement	4.5-7.0 N·m
Impart Bar to Skid Plate	20-34 N·m
Bottom Rear Fascia to Impact Bar	1.2-1.0 N·m
Fascia to Skid Plate	1.2-1.0 N·m
Inpact Bar to Front Cross Tie Member	20-34 N·m
Front Air Deflector	8.0-11 N•m

REAR BUMPER FASTENER TORQUE

Top Fascia to Body	1.2-1.6N ·m
Upper and Lower Fascia to Body	2.2-3.4 N·m
Fascia License Plate Opening	1.6-2.2 N·m

SECTION 3

DIAGNOSIS OF: STEERING, SUSPENSIONS, WHEELS AND TIRES

CONTENTS

General Information 3-1
Power Steering Rack and Pinion, and Pump 3-2
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Future sales require that we provide our customers full satisfaction and goodwill. Despite the best intentions to deliver a problem-free vehicle, we must quickly resolve any complaints.

If you have exhausted all the available information contained in this section, and cannot resolve the problem, please use the "Technical Assistance Network". Always road test the vehicle first with the customer (if at all possible). Because steering, suspensions, and wheels and tires are related, all must be considered when diagnosing a complaint.

GENERAL DIAGNOSIS INFORMATION

GENERAL DESCRIPTION

Steering and handling complaints can overlap into several systems. Steering, suspensions, wheels and tires are often related. Avoid being misled by the wrong sympton, always road test the vehicle first, and with the customer if possible.

To give professional service to the customer, attach an "inspection report", or a note of your survey to the work order.

Check the following before road testing:

1. Tire pressure. See the label, on rear of the driver's door, for the recommended tire pressure.
2. Tires for uneven wear (alignment/balance).
3. Sidewall scuff (bent rim).
4. Obvious incorrect trim height (spring). See wheel alignment Section 3A (trim height chart).
5. Loose or tight steering condition (steering gear, linkage, column assy., or ball joint.)
6. Push down, jounce, all four (4) corners of the vehicle. (The shocks should react smooth and constant.)
7. Overloaded vehicle (excessive load). See label, on rear of driver's door, for the rated weight.
8. Power steering fluid level (leak).

Abnormal or Excessive Tire Wear

- Tire out of balance.
- Wheel alignment.
- Tires not rotated at proper intervals. See Section 3E.
- Excessively hard driving.
- Non-recommended wheel or tire.

Scuffed/Bruised Tire

- Collision with road hazzard or curb.
- Check suspension and steering components, also look for bent wheels. Alignment check is recommended.
- Incorrect toe setting.
- Excessive speed in turns.

Cupped Tires

- Faulty shock.
- Faulty suspension or steering component.
  - Suspension rubber bushing, ball joint or tire/wheel runout.

Trim Height

(See Section 3A)

- Faulty spring.
- Incorrect spring.
- Excessive load.

Loose Steering

- Steering shaft assembly or gear mounting loose.

- Steering linkage or knuckle attachment loose.
- Wheel nuts/studs loose or faulty.
- Loose or faulty ball joint.
- Loose or faulty wheel bearing assembly.

Check the following symptoms after road testing:

Shimmy, Shake or Vibration

- Tire or wheel out of balance.
- Excessive wheel or tire runout.
- Faulty tire.
- Faulty or loose wheel bearings.
- Faulty or loose ball joint.
- Faulty or loose steering linkage or tie rods.
- Loose wheel nuts/studs.
- Loose steering knuckle or control arm.
- Incorrect wheel alignment.
- Loose or faulty control arm bushing.
- Faulty shock.
- Faulty or bent drive axle.

Wheel Tramp

- Faulty tire.
- Faulty shocks.

Abnormal Noise, Suspension

- Loose suspension nuts/bolts.
- Loose or broken shock.
- Loose or broken stabilizer bar assembly.
- Loose control arm bushing.
- Loose spring or faulty spring bushing.
- Loose wheel nuts.
- Lack of lubrication -- ball joint/tie rod end.
- Wheel bearings faulty.

Harsh Ride

- Heavy duty suspension package. Inform owner.
- Incorrect springs.
- Incorrect shock.

Suspension Bottoms

- Incorrect, broken or weak springs.
- Faulty shock.
- Excessive load. Check label on rear of driver's door.

Vehicle Rolls or Leans in Turns

- Loose stabilizer bar, or needs stabilizer bar.
- Sagging springs.
- Excessive load. Check label on rear of driver's door.
- Incorrect wheel alignment.

"Dog Tracking"

- Incorrect rear toe.
- Faulty or bent rear suspension component.
- Suspension/body misalignment.

Wander or Poor Steering Stability, Pulls/Leads

- Mismatched or incorrect tire sizes.
- Faulty radial tire.
- Faulty shock.
- Loose or broken stabilizer assembly.
- Broken or weak spring.
- Steering gear defect or misadjusted.
- Incorrect wheel alignment.
- Faulty brake caliper or rotor.
- Faulty wheel bearings.

Erratic Steering When Braking

- Warped or faulty brake rotor.
- Broken or weak spring, or shock.
- Foreign material on brake pads.
- Faulty brake pads/shoes.
- Faulty wheel bearings.

STEERING RELATED SYMPTOMS

Hissing Noise in the Hydraulic System

There is some noise in all power steering systems. One of the most common is a hissing sound that is most evident at standstill parking. There is no relationship between this noise and performance of the steering. "Hiss" may be expected when steering wheel is slowly turning at standstill. Do not replace valve unless "hiss" is extremely objectable. A replacement valve WILL also exhibit slight noise, and is not always a cure for the objection.

Abnormal Noise, Power Rack and Pinion-Rattle

- Rack and pinion gear loose.
- Pressure hose touching other parts of vehicle.
- Rack and pinion preload adjustment.

Rattle or Chuckle Noise in Rack and Pinion

- Pressure hose touching other parts of vehicle.
- Tie rod ends loose.
- Rack and pinion gear loose.

Growl Noise in Steering Pump

- Check fluid level and color. (Low level/air in fluid-leak).
- Excessive back pressure in hoses or steering gear caused by restriction.
- Install a pressure gage into the system. Check for excessive pressure.

Growl Noise in Steering Pump

- Faulty pressure plate, thrust plate or rotor.
- Faulty cam ring.

Groan Noise in Steering Pump

- Air in the fluid.
- Low fluid level.
- Pump mounting loose.

Rattle Noise in Steering Pump

- Faulty vanes.
- Vanes sticking in rotor slots.

Swish Noise in Steering Pump

- Faulty flow control valve.
- Low fluid level/air in the system.

Whine Noise in Steering Pump

- Faulty pump shaft bearing.
- Scored pressure plate and vanes.

Steering Wheel Kickback/Pulsates

- Air in system. (Low fluid level-leak).
- Loose or faulty pump drive belt.
- Faulty flow control valve.
- Test the system with tool J-5176-1 or J-25323 or equivalent hydraulic system test unit.
- Loose steering linkage.
- Loose steering gear.
- Loose or faulty wheel bearing assembly.

Poor Return of Steering Wheel To Center

- Wheel alignment.
- Faulty wheel bearings.
- Faulty tie rod or ball joint.
- Faulty steering shaft bearings.
- Steering gear preload incorrect.
- Faulty spool valve.

Hard Steering

- Faulty tie rod or ball joints.
- Faulty steering shaft bearings.
- Steering gear preload incorrect.
- Loose or faulty power steering pump belt.
- Low fluid level or air in the system.
- Low or no hydraulic pump pressure.
- Make system test with gage J-5176-1 or J-25323.
- Upper strut bearing faulty.

Hard Steering or Lack of Assist (Especially During Parking)

(Install Pressure Gage)

- Brakes applied when parking. (Vehicle not in motion).
- Intermediate shaft faulty or worn.
- Sticky flow control valve.
- Insufficient pump pressure output.
- Excessive internal pump leakage.
- Excessive internal rack and pinion leakage.

Foaming Milky Power Steering Fluid, Low Fluid Level,

and Possible Low Pressure

Air in the fluid, and loss of fluid due to internal pump leakage causing overflow. Check for leak and correct. Bleed system. Extremely cold temperatures will cause system aeration if the oil level is low. If oil level is correct, and pump still foams, remove pump. Check for internal leakage.

Low Pressure Due to Steering Pump

(Install Pressure Gage)

- Flow control valve stuck or inoperative.
- Pressure plate not flat against cam ring.
- Extreme wear of cam ring.
- Scored pressure plate, thrust plate or rotor.
- Vanes not installed properly.
- Vanes sticking in rotor slots.
- Cracked or broken thrust or pressure plate.

Low Pressure Due to Rack and Pinion

(Install Pressure Gage)

- Pressure loss in cylinder due to worn or faulty piston ring, or scored housing bore.
- Leakage at pinion/valve rings.

After the source of the problem has been found, determine the cause. For example, if the fluid level in the reservoir is found to be low, refill and check the entire hydraulic system for fluid leaks. Refilling the reservoir will not necessarily correct the problem.

EXTERNAL LEAKAGE DIAGNOSIS

General Procedure

1. Wipe suspected area dry.
2. Check for overfilled reservior.
3. Check for fluid aeration and overflow.
4. Check hose and fluid supply line connections. Tighten if necessary. Use specified torque.
5. Verify exact point of leakage. Example: The point fluid drips from is not necessarily the leakage point-overflowing from reservoir for instance.
6. When service is required:
   a. Clean leakage area upon disassembly.
   b. Replace leaking seal or faulty component.
   c. Check component sealing surfaces for damage.
   d. Torque to specifications where required.

Customer Complaints

Some of the customer complaints associated with the power steering systems may be reported as:

Fluid leakage on driveway.

2. Fluid leaks visible on steering assembly, pump or anywhere else in the engine compartment near the steering system.
3. Growling noise, especially when parking or when engine is cold.
4. Heavy steering effort.

External Leakage Check

The purpose of the diagnostic procedure to pinpoint the location of the leak. The method outlined in this manual can be followed to locate the leak and repair it.

In some cases, you will be able to locate the leak easily. However, seepage-type leaks may be more difficult to locate. For seepage leaks, the following procedure is recommended.

1. With the vehicle's engine off, wipe the complete power steering system dry (gear, pump, hoses, and connections).
2. Check fluid level in pump's reservoir and adjust as required.
3. Start engine and turn steering wheel from stop to stop. Do not hold in full turn position for any length of time, as this puts undue strain on the power steering pump. It is easier if someone else operates the steering wheel while you search for the seepage.
4. Find the exact area of leakage.

Quick Fixes

The purpose of this section is to acquaint you with the types of leakage which can be repaired very easily. It contains information on reservoir fluid level, the hoses, and the hose connections.

An OVERFILLED pump reservoir can be the cause of a leakage complaint. The fluid in the steering system expands as it is heated during normal usage. If overfilled, the excess fluid is forced through the reservoir cap vent.

- Operate the engine and steering system until normal operating temperature is obtained. Stop engine. Remove the reservoir cap and check the level. Adjust the fluid level as required.

SEEPAGE at the hose connections can be the cause of a leakage complaint, and can be just a loose connection. If leakage is observed at the hose connections, and the fitting is not cross threaded, tighten the pressure and return lines. Always check the O-ring seals. If the leak continues, refer to pump diagnostic chart (Figure 3-1).

- If either the return/pressure hoses, or cylinder lines leak, other than at the fittings, replace the leaking part.

Component Replacement Recommendations

Lip seals, which seal rotating shafts, require special treatment. This seal type is used on the steering gear at the pinion shaft, and on the drive shaft of the pump. When leakage occurs in one of these areas, always replace the seal or seals. Inspect and thoroughly clean the shaft surface on which the seal rides. Use a vernier caliper to check the shaft dia. (compare) with the lip seal contact dia. Replace the shaft only if severe wear is found, 1mm (.040 in.) or more. If wear in the lip seal contact zone is slight, clean the surface of the shaft with a crocus cloth. Replace the shaft when the leakage cannot be stopped by smoothing with crocus cloth first.

Housing or cover seepage. Fluid loss may occur from the gear or pump due to porus castings. If this type of leakage is found, replace the leaking part.

Individual Leakage Breakdown

The following diagrams in Figures 3-1 and 3-2 have been prepared to show the potential area of leakage. If leakage occurs in the areas shown, replace the part listed using the service manual as a guide. See Sections 3B1 and 3B3.

INTERNAL LEAKAGE DIAGNOSIS

Fluid Pressure Check

1. Disconnect pressure hose at pump. Use a small container to catch any fluid which might leak.
2. Connect a spare pressure hose to pump union.
3. Using pressure gage J-5176-01, adapter fitting J-5176-5, connect gage to both hoses.

The power steering system may be tested using either J-5176-02 as described here or with available tool J-25323, adapter fitting J-28579, Power Steering Analyzer, which will measure flow rate in addition to pressure.

4. OPEN THE VALVE ON GAGE.
5. Start engine, allow system to reach operating temperature. Stop engine and check fluid level, adding fluid if required. When engine is at normal operating temperature, the pressure reading on the gage (valve open) should be in the 552-862 kPa (80-125 psi) range. IF THIS PRESSURE is above 1380 kPa (200 psi) STOP ENGINE, check the hoses for restrictions and popper valve for proper assembly.
6. Start the engine and let it idle, close valve fully 3 times (to shut-off flow), and record the highest pressure attained each time. DO NOT leave valve fully CLOSED for more than 5 seconds.
   a. If the pressure recorded is within 345 kPa (50 psi), the pump is functioning within specifications.
   b. If the pressures recorded are high, but do not repeat within 345 kPa (50 psi), the flow control valve in the pump is sticking. Remove the valve, clean it and remove any burrs using crocus cloth or fine hone. If the system contains foreign material, flush it. If it is exceptionally dirty, both the pump and the rack and pinion may have to be completely disassembled, cleaned, inspected and reassembled before further usage.
   c. If the pressures recorded are constant, but more than 690 kPa (100 psi), below 9308 kPa (1380 psi), replace the flow control valve and recheck. If the pressures are still low, inspect the rotor and vanes.
7. If the pump pressure meets specification, leave the valve OPEN and turn (have second person help) the steering wheel to both stops. Record the highest pressures and compare with the maximum pump pressure recorded. If pressure is not the same (at both stops) as maximum pressure, the rack and pinion is leaking internally and must be disassembled and repaired.
8. Shut off engine, remove testing gage, spare hose, reconnect pressure hose, check fluid level or make needed repairs.

BASIC STEERING COLUMN TROUBLESHOOTING

The folloiwng symbols indicate steering column application: ALL COLUMNS (No Symbols); (*) Tilt Column Key Release Only; (**) Standard Column Key Release Only.

LOCK SYSTEM

Will Not Unlock

- Faulty lock bolt.
- Faulty lock cylinder.
- Faulty housing.
- Faulty rack.

Will Not Lock

- Broken or faulty lock bolt spring.
- Faulty lock cylinder.
- Burr on lock bolt or sleeve in steering column housing.
- Faulty housing.
- Transmission linkage adjustment incorrect.
- Faulty rack.
- Interference between the column and ignition switch actuator assembly (*).
- Ignition switch stuck.
- Actuator rod restricted.

High Lock Effort

- Faulty lock cylinder
- Faulty ignition switch.
- Broken or deformed rack.
- Burrs on rack, housing, support or acturator rod.
- Faulty rack.
- Extreme misalignment of housing to cover. (*)
- Distorted coupling slot in rack. (*)
- Bent actuator rod.
- Bent ignition switch mounting bracket.
- Restricted actuator rod. (**)
- Improper shift cable adjustment.

Will Stick In "Start"

- Actuator rod deformed.
- Check items under "High Lock Effort."

Key Cannot Be Removed In "Off-Lock"

- Faulty rack.
- Faulty lock cylinder.

High Effort On Lock Cylinder Between "Off" and "Off-Lock"

- Distorted rack. (**)
- Burr on tang of shift detent.

COLUMN ASSY.

Noise In Column

- Intermediate shaft pinch bolt not tightened. Tighten pinch bolts.
- Column not correctly aligned.
- Horn contact ring not lubricated (silicone electrical).
- Lack of grease in bearings.
- Lower or upper steering shaft bearing faulty.

High Steering Shaft Effort

- Column assembly misaligned.
- Faulty upper or lower bearing.
- Tight intermediate steering shaft universal joint.

Lash In Mounted Column Assembly

- Instrument panel bracket to column weld nut mounting screws loose.
- Broken weld nuts on jacket.
- Instrument panel upper bracket capsule sheared.
- Loose shoes in housing.(*)
- Loose tilt head pivot pins.(*)
- Loose shoe lock pin in support.(*)
- Loose support screws.
- Instrument panel to jacket mounting bolts loose.

Steering Wheel Loose

- Excessive clearance between holes in support or housing and pivot pin diameters.(*)
- Faulty or missing preload spring in spheres.(*)
- Upper bearing not seated in housing.(*)
- Upper bearing inner race seat missing.(*)
- Loose support screws.
- Bearing preload spring missing or broken.(*)
- Improperly adjusted tilt and telescoping lock knobs.(*)

Steering Wheel Loose (Every Other Tilt Position)

- Loose fit between shoe and shoe pivot pin.(*)
- Shoe not free in slot.(*)

Steering Column Not Locking In Any Tilt Position

- Shoe seized on its pivot pin.(*)
- Shoe grooves may have burrs or dirt.(*)
- Shoe lock spring weak or broken.(*)

Steering Wheel Fails To Return To Top Tilt Position

- Pivot pins are bound up.(*)
- Wheel tilt spring is faulty.(*)

Noise When Tilting Column

- Upper tilt bumpers faulty or missing.(*)
- Tilt spring rubbing in housing.(*)

Miscellaneous

- Housing loose on jacket - will be noticed with ignition in "Off-lock" and a torque applied to the steering wheel.
- Support loose on jacket.

SIGNAL SWITCH

Turn Signal Will Not Stay In Turn Position

- Foreign material or loose parts impending movement of yoke or switch out of adjustment.
- Broken or missing detent or cancelling spring.
- None of the above. Replace switch.

Turn Signal Will Not Cancel

- Loose switch mounting screws or switch out of adjustment.
- Switch or anchor bosses broken.
- Broken, missing or out of position detent, return or cancelling spring.
- Uneven or incorrect cancelling cam to cancelling spring interference 3 mm/side.

Turn Signal Difficult To Operate

- Signal switch arm loose.
- Yoke broken or distorted. Replace switch.
- Loose or misplaced springs.
- Foreign parts and/or material.
- Loose switch mounting screws. Tighten mounting screws.

Turn Signal Will Not Indicate Lane Change

- Broken lane change pressure pad, spring hanger or pivot assembly pin preload spring.
- Broken, missing or misplaced lane change spring.
- Jammed base or wires.

Hazard Switch Cannot Be Turned Off

- Foreign material between hazard support cancelling leg and yoke.
- No foreign material blocking function of switch. Replace turn signal switch.

Hazard Switch Will Not Stay On or Difficult To Turn Off

- Loose switch. Tighten mounting screws.
- Interference with other components.
- Foreign material interference.
- Replace switch.

No Turn Signal Lights

- Check the fuse.
- Electrical failure in Chassis harness.
- Inoperative turn signal flasher.
- Loose chassis/switch connector.
  Disconnect switch to harness connector (below column). Connect new switch and operate switch by hand.
- If lights now operate normally, signal switch is faulty.
- If lights do not operate, refer to Section 8.

Turn Indicator Lights On, But Not Flashing

- Check flasher.
- Check light sockets and bulbs.
- Loose chassis to switch connection.
- Inoperative turn signal switch.
- Check for burned out front or rear turn signal bulb.
- Check for open ground circuit.
  To determine if turn signal switch is faulty, substitute new switch into circuit (below at harness connector) and operate switch by hand.
- If the lights operate normally, signal switch should be replaced.
- If lights do not operate, refer to Section 8.

Front Or Rear Turn Signal Lights Not Flashing

- Check fuse.
- Burned out or faulty turn signal bulb. Refer to Section 8.
- Check for open ground circuits.
- Loose chassis to column connector.
  Disconnect switch to harness connector (below column). Connect new switch and operate switch by hand.
- If turn signal lights are now on and flash, turn signal switch is faulty.
- If lights do not operate, refer to Section 8.

Turn Indicator Panel Lamp

- Burned out bulb.
- Open ground in wiring harness from front turn signal bulb socket to indicator lights, refer to Section 8.

Stop (Opposite) Light Not On When Turning

- Loose chassis to switch connection.
- Disconnect switch to harness connector. Connect new switch into system and operate switch by hand.
- If stop light works with switch in the turn position, signal switch is faulty.
- If stop light does not work, refer to Section 8.

Turn Signal Lights Flash Very Slowly

- Loose harness to switch connection.
  Disconnect switch to harness connector. Connect new switch into system without removing old switch and operate switch by hand.
- If flashing occurs at normal rate, the signal switch is faulty.
- If the flashing rate is still extremely slow, check flasher, bulbs and sockets. Check socket ground wire.
- Check for open wire harness.

Hazard Signal Lights Will Not Flash - Turn Signal Functions Normally

- Blown fuse.
- Inoperative hazard warning flasher.
- Loose harness to switch connection.
  Disconnect switch to harness connector. Connect new switch into system, depress the hazard warning button and observe the hazard warning lights.
- If they now work normally, the turn signal switch is faulty.
- If the lights do not flash, check wiring harness. Refer to Section 8.

IGNITION SYSTEM

Electrical System Will Not Function

- Faulty ignition switch.
- Ignition switch not adjusted properly.
- Check for ECM Code 46. See Section 6E3.
- Loose connection in ignition system.
- See Section 8A (VATS).

Switch Will Not Actuate Mechanically

- Faulty ignition switch.
- Switch actuator rod binding.

Switch Cannot Be Set Correctly

- Switch actuator rod deformed.
- Sector to rack engaged in wrong tooth.(*)
- Faulty switch.

KEY BUZZER

(Figure3-3 thru 3-13)

Buzzer Continues To Operate With Key Out, But Stops When Driver's Door Is Closed

- Chips, foreign material in lock cylinder bore.
- Sticky lock cylinder actuator tip.
- Faulty buzzer switch.

Buzzer Does Not Sound With Key Fully Inserted In Lock Cylinder With The Driver's Door Open

1. Check fuse, OK. Power not available at buzzer, refer to Section 8.
2. Open in chassis wiring. Check by separating switch to harness connector. A jumper wire can be used. If buzzer sounds, go to step 4. If not, locate and repair chassis wiring.
3. If the problem has not yet been detected, use a self powered test light or an ohmmeter. Insert the key the full depth into the lock cylinder. If light is on with the key in, and off with key out, the switch is not the problem. If the light is not on, the problem is in the switch or switch harness. Proceed to Step 4.
4. With the problem isolated in the column, disassemble the upper end of the column until the buzzer switch and wires are exposed. Lift the buzzer switch and check with test light or ohmmeter. Check the function, as in Step 3.
5. Short or open in buzzer switch wiring. Connect jumper. Using a self powered test light or ohmmeter, check across contact on the buzzer switch. If test lamp lights, function is normal. If not, replace the switch.
6. If the problem has not yet been isolated and repaired, connect a self powered test lamp to the buzzer switch. Fully insert and remove the key from the lock cylinder. If light is on with the key in, and is off with key out, this function is normal. Retrace diagnostic steps starting at Step 4. If light is not on, the problem is in the lock cylinder or buzzer switch. Remove buzzer switch and check.
7. Chips, burrs, foreign material in lock cylinder may prevent actuator tip function. Remove chips, burrs, etc. Reassemble and re-check. See Step 6.

   NOTICE: Key must be removed or cylinder placed in "run" position before removing lock cylinder.

8. Faulty lock cylinder. With the lock cylinder removed, fully insert and remove the key. The actuator tip should extend and retract smoothly. Total extension of tip should be 1.3 mm (.050 in.) minimum. If not, replace lock cylinder. Remove and clean as required. Reassemble and re-check per Step 6.
9. Chips, or foreign material in buzzer switch.
10. Faulty or broken buzzer switch.
11. Switch appears good but will not operate.
    Connect a self powered test light or ohmmeter leads to the buzzer switch. Press on the actuator pad until the interior points contact. If contact is not made, replace buzzer switch.
12. Buzzer switch internal contact gap too large. Reset contact gap.
13. Setting the contact gap. Press a .8 mm (.030 in.) wire type spark plug gap wire with flat piece of stock on the actuator pad. If contact is not made, adjust switch until positive contact is made. With positive contact at .8 mm (.030 in.), use a .6 mm (.025 in.) plug gap wire beneath the flat stock. No contact should occur. Adjust until the switch will make contact with the .8 mm (.030 in.) wire and not with the .6mm (.025 in.), the buzzer switch is set at the low limit.

Buzzer continues to operate with key in the lock cylinder with the driver's door either opened or closed and ceases when key is removed.

1. Door jamb switch on driver's side misadjusted or inoperative.
2. Wire from signal switch to door jamb switch shorted.
3. Insert key into cylinder lock and turn lock toward "START" position. If buzzer stops in "RUN" towards "START," the problem is a sticky lock cylinder actuator.

Dimmer Switch

- Loose connector at harness connector.

- Improper adjustment.
- Internally faulty or worn switch. Check continuity at the harness connector with full depression of plunger. (Audible Click).
- No continuity. Replace dimmer switch. Continuity. Refer to Section 8.

SHOCK ABSORBER DIAGNOSIS

(Figure 3-14)

This procedure includes both on-vehicle and bench checks to be performed in diagnosing the shock.

On-Vehicle Checks

Weak SHOCKS

1. Check and adjust tire pressures. See label on rear of driver's door.
2. Note load conditions under which the vehicle is normally operated.
3. If practical, ride with owner to understand complaint before proceeding to next step.
4. Test each shock in turn by quickly pushing down (jouncing) and then lifting up on the corner of the bumper nearest the shock being checked. Use the same amount of effort on each test and note the resistance provided by the shock on compression and rebound. Compare with a similar vehicle having acceptable ride quality. Both should provide the same feeling of resistance. The stabilizer assembly, will make detection very difficult.

Noisy Shocks

1. Check all mounting torques (bolt and/or nut). A loose mounting will very definitely cause a noise noticeable to the customer.
2. If all mountings are intact, jounce the vehicle (See Step 4 above) to isolate the suspected unit.
3. If practical, ride with owner to understand the complaint, before proceeding to next step. A hissing noise is considered normal. A grunt or squeal after one full stroke in both directions is abnormal. A clicking noise on fast reverse is abnormal. Abnormal conditions require replacement.

Shock Leakage

Off-Vehicle Bench Checks

1. Visually inspect for evidence of leakage on body of the shock.

Check For Faulty Shocks

1. Stroke strut by hand at various rates of speed and observe resistance.
2. REBOUND offers more resistance than compression (approximately 2 to 1). However, resistance should be smooth and constant.
3. Compare with a known good shock.
4. It is normal to detect a hissing noise. The following are considered abnormal and reason for replacement:
   - A skip or lag at reversal near mid-stroke.
   - A seize (except at either extreme end of travel).
   - A noise such as grunt or squeal after completing one full stroke in both directions.
   - A clicking noise at fast reversal.
   - Fluid leakage.

New Shocks

They should be initially cycled before attempting a bench check. When stored in a horizontal position, such as new units in stock, an air void can develop in the pressure chamber.

Perform the following steps to purge air from the pressure chamber:

1. Extend in vertical position - top end up.
2. Collapse in vertical position - top end down.

Repeat above steps five(5) more times to make sure air is purged from the pressure chamber.

TIRE DIAGNOSIS

IRREGULAR AND/OR PREMATURE WEAR

Figure (3-20)

Irregular and premature wear has many causes. Some of them are: incorrect inflation pressures, lack of tire rotation, driving habits, wheel alignment, faulty tire (radial belts), shock/strut, imbalance of tire, wheel, drum rotor or drive axle.

If the following conditions are noted, wheel and tire rotation is in order:

- Front tire wear is different from rear.
- Uneven wear exists across the tread of any tire.
- Left front and right front tire wear is unequal.
- Left rear and right rear tire wear is unequal.

A wheel alignment check is in order if the following conditions are noted:

1. Left and right front tire wear is irregular.
2. Wear is uneven across the tread of any front tire.
3. Front tire treads have scuffed appearance with "feather" edges on one side of tread ribs or blocks.

WEAR INDICATORS

Figure (3-21)

The original equipment tires have built-in tread wear indicators to show when tires need replacement. These indicators will appear as 12.7mm (1/2 in.) wide bands when the tire tread depth becomes 1.6mm (1/16 in.). When the indicators appearin 2 or more grooves at 3 locations, tire replacement is recommended.

RADIAL TIRE WADDLE

(Figure 3-16)

Waddle is side to side movement at the front and/or rear of the car. It can be caused by a steel belt not being straight within the tire. It is most noticeable at low speed, 8 to 48 kph (5 to 30 mph). It may also appear as a ride roughness at 80 to 113 kph (50 to 70 mph).

It is possible to road test and tell which end the faulty tire is located. If the waddle tire is on the rear, the rear end will shake from side to side, or "waddle". From the driver's seat, it feels as though someone is pushing on the side of the vehicle.

If the faulty tire is on the front, the waddle is more visual. The front sheet metal appears to be moving back and forth and the driver feels as though he is at the pivot point.

Waddle can be quickly diagnosed by using a Tire Problem Detector (TPD).

The TPD is simply a roller drum that slowly rotates the tire, on the vehicle, while under load (checking spindle variation).

If a TPD is not available, the more time consuming method of substituting known good tire/wheel assemblies can be used as follows:

1. Road test to determine if the waddle is coming from the front or rear.
2. Install tires and wheels that are known to be good (on similar car) in place of those on the offending end. If the waddle cannot be isolated to front or rear, substitute the front tires for the rears.
3. Road test again. If improvement is noted, install originals one at a time until the faulty tire is found.

RADIAL TIRE LEAD

(Figure 3-17)

"Lead" is the deviation from a straight path on a level road with no pressure on the steering wheel.

The feeling of tire lead may be caused by a crowned roadway, incorrect wheel alignment, faulty tire construction, inconsistent tire pressure, or even from cross winds. Be sure to check first, tire pressure and tire wear patterns.

The way in which a tire is built can produce lead. An example of this, is placement of the belt. Off center belts on radial tires can cause the tire to develop a side force while rolling straight down the road. If one side of the tire is a little larger diameter than the other, the tire will tend to roll to one side. This will develop a side force which can produce lead. Exchange right front for left front. If the lead now appears on the other side, it is a good chance that the tire is faulty.

NOTE: This procedure should be used to make sure that wheel alignment is not mistaken for tire lead. Some alignment technicians have been known to alter the alignment specifications, to correct for a faulty tire.

If a medium to high mileage tire is moved to the other side, be sure to check that ride roughness has not developed. The tire may be moved to the rear. Rear tires usually will not cause lead.

FOUR (4) WHEEL ALIGNMENT

(Figure 3-18)

The tire tread surface, that has contact with the road, is not much more than that of a post card, but, is responsible for the safety and handling of the entire vehicle. This makes four (4) wheel alignment an issue to address .

The concept is to align all four (4) wheels to track as a unit. To be in full alignment, the THRUST line must be in the exact same parallel plane as the geometric vehicle CENTER line.

If the rear axle is not exactly square with respect to the front geometry, the thrust line will deviate from the center line of the vehicle resulting in LESS than optimim performance and handling ease.

VIBRATION ELIMINATION PROCEDURE

Prior to performing any work, always **road test** the vehicle.

Visual Inspection

- Proper inflation pressure.
- Bent rims from an ensuing chuckhole or curb impact.
- Faulty tires, such as tread distortions, separations, or bulges. Slight sidewall indentations are normal and will not affect ride. Sidewall bulges are not normal and indicate impact damage.
- Mud or tar build-up on the tire or wheel.
- Replacement wheel/tire which does not conform to the original part, or is of lesser quality or substitute design.
- Loose or missing - balance weights or wheel nuts.
- Irregular or excessive tire wear.
- Make sure that the tire is match mounted.
- Bent or faulty drive axle.

Road Test

Warm up the tires first to eliminate any flat spotting. This may be done during a road test.

Engine Related Vibration: See Section 6

Low-Speed Vibration

Less than 64 mph (40 kph) is usually **RUNOUT** related.

High-Speed Vibration

GREATER than 64 kph (40 mph) is usually the result of **IMBALANCE** , but may be a vectorial product of both runout and imbalance.

Perform Wheel Balance

Before removing the tire/wheel assembly from the vehicle, mark the stud bolt nearest the valve stem for future reference. Also mark the vehicle position (left front, etc.) on each tire.

BALANCE is the easist procedure to perform and should be done first if the vibration occurs at highway speeds. An off-vehicle, two-plane dynamic balance should first be performed. This will correct any imbalance in the tire/wheel assembly. An on-vehicle finish balance may also be required. This may offset brake drum, rotor, drive axle, or wheel cover imbalance. Follow the balancing procedures outlined.

If balance does not correct the highway speed vibration, or if the vibration is at low speeds, runout may be the probable cause. RUNOUT is a bit more time consuming to diagnose. It can be caused by the drive axle, tire, the wheel, the bearing assembly, or the way the wheel attaches to the vehicle.

Perform Runout Check

(Figure 3-19)

1. The free runout of the tire/wheel assembly should first be measured on the vehicle. A DIAL INDICATOR with a roller wheel should be used. Lateral runout (side to side) should be measured on the tire's sidewall as close to the tread shoulder as possible. Radial runout (up and down) should be measured on the center tread rib. Some tread designs may require tightly wrapping a piece of tape around the center tread circumference for better dial indicator contact. Whether measuring radial or lateral runout, disregard any instantaneous indicator neeedle jumps due to sidewall depressions, tread blocks, etc. Record the total indicator reading, and the location of the high point of runout. If either measurement exceeds 1.523mm (.060″), proceed to Step 2.
2. If the radial or lateral runout measured in Step 1 exceeds .060″, mount the tire/wheel assembly on a dynamic balance machine and again measure the amount of runout. The wheel must be centered on the machine by the wheel's center pilot hole. Using the same procedure as in Step 1, record the amount of runout and its high point location. If either measurement, radial or lateral, exceeds 1.269mm (.050″), proceed to Step 3.
3. If the radial or lateral runout measured in Step 2 exceed 1.269mm (.050″), break down the assembly and rotate the tire on the rim 180°. Reinflate, mount on the dynamic balance machine, and again measure and record the radial and lateral runout, and its location, as in Step 2. In many cases, rotating the tire on the wheel will bring the assembly's runout into the acceptable range of less than 1.269mm (.050″). If not, proceed to Step 4.
4. If after rotating the tire 180° on the wheel, the radial or lateral runout still exceeds 1.269mm (.050″), and the high point has moved approximately 180° (followed the tire around the rim), the tire is the major contributor and should be replaced. If the second high point still exceeds 1.269mm (.050″), and is close to the original high point (relative to the rim), the wheel is the major contributor. Before replacing the wheel, break down the assembly and measure the wheel separately. Replace the wheel if radial runout exceeds .761mm (.030″) (aluminum wheels) or lateral runout exceeds .761mm (.030″) (aluminum wheels).
5. If the runout of the tire/wheel assembly is within limits when measured off the vehicle, yet exceeds the limits when measured on the vehicle, the attachment of the tire/wheel assembly to the hub is the probable cause. Rotate the assembly two stud bolts and recheck the runout. Several positions may have to be tired to find the best location. If the runout cannot be reduced to an acceptable level, remove the tire/wheel assembly and measure hub stud runout with the dial indicator. If runout exceeds .761mm (.030″), the hub or drive axle shaft should be replaced.

Whenever a tire is rotated on the wheel, or a tire or wheel is replaced, the assembly must be rebalanced.

NOTE: If vehicle is equipped with the LTPWS (Low Tire Pressure Warning System), see Section 3E.

Tire Defect Check

TIRE STIFFNESS variation, or LOADED RADIAL RUNOUT can also cause a vibration. However, this is difficult to measure without a **TPD** (Tire Problem Detector) or a loaded radial runout buffer.

The **TPD** is simply a roller drum that slowly rotates the tire, while under load, (mounted on the vehicle) measuring spindle movement.

The loaded radial runout buffer is a more automated machine that slowly rotates the tire under load with a roller drum off the vehicle and measures the tire's stiffness. It will then "match" the tire to the wheel by buffing off small amounts of rubber from the outer tread rows at the stiff spot. This procedure is usually effective, especially when used as a measuring device and for fine buffing only. However, this equipment requires careful use. Do not remove too much rubber.

However, because such equipment is not always available, the most basic procedure of measuring free runout with a dial indicator, as previously detailed, is usually more practical. The free runout of the tire will usually correspond with the tire's stiff spot.

Substitution Method

Install a known good set of tire/wheel assemblies. If these correct the vibration, the original assemblies should be reinstalled one at a time until the vibration returns.

NOTE: If vehicle is equipped with the LTPWS (Low Tire Pressure Warning System), see Section 3E.

RUBBER BUSHINGS/TIE ROD ENDS BALL JOINTS

To give professional service to the customer, attach an "inspection report", or a note of your survey, to the work order.

Bushings

All suspension components front and rear should be eye-balled for wear or obvious damage. Use a pry bar or suitable tool to move suspension components. Replace any worn or loose bushings.

Tie Rod Ends/Ball Joints

(Figure 3-20)

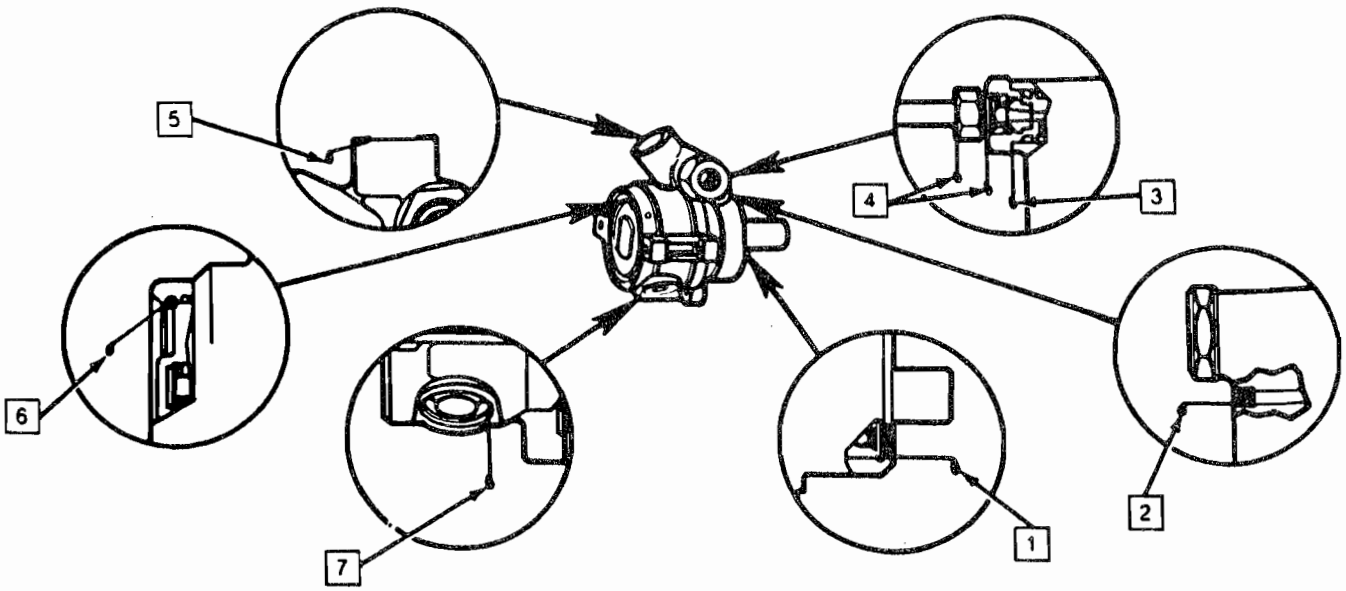
If cuts or tears of the seals are found, the tie rod ends and ball joints should be replaced.

- The tie rods should have no free play.
- Raise vehicle (do not lift by the lower control arm) by lifting at the frame. Mount a dial indicator to record vertical movement of the lower control arm to knuckle attachment, the ball joint. Raise and lower the wheel and tire. Record the vertical movement. Movement should not exceed 1.269mm (.050").

Steering Gear Rack and Pinion Boot

Visually inspect for cuts or lubricant leakage. A torn boot WILL lead to damage.

Check for loose boot clamps.

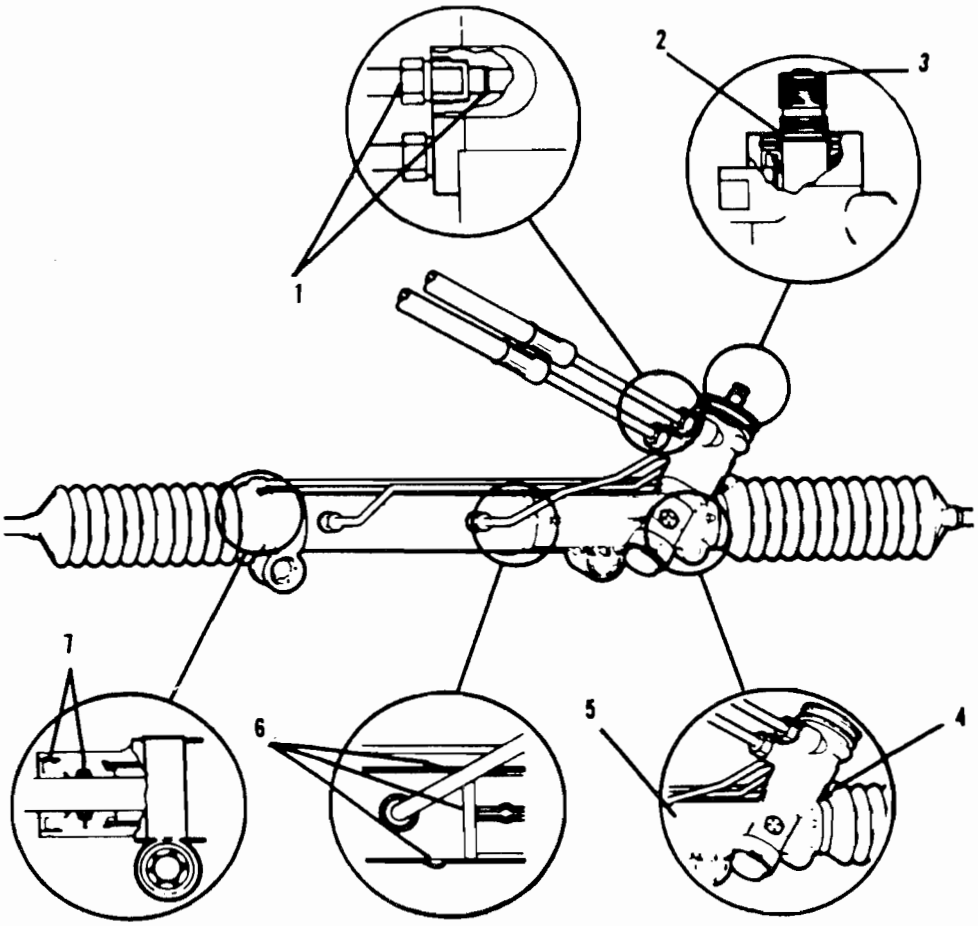


1. Replace drive shaft seal. Make certain that drive shaft is clean and free of pitting in seal area. Bench repair.
2. Seat ball in housing with blunt punch. Following manufacturer's directions apply loctite 75559 solvent and loctite 290 adhesive, or equivalent, to area.
3. Torque fitting to 75 N·m (55 Ft. Lbs.). If leakage persists, replace O-ring seal. Bench repair.
4. Torque hose fitting nut to 35 N·m (25 FT. Lbs.). If leakage persists, replace O-ring seal.
5. If leakage is observed, replace O-ring, reservoir, or pump case.
6. Replace O-ring seal. Bench repair.
7. Seat plug in housing. Following manufacturer's directions apply loctite 75559 solvent and loctite 290 adhesive, or equivalent, to plug-housing area.

   Check for defective or cracked reservoir.

Figure 3-1 Pump External Leak Diagnosis

RACK & PINION LEAK DIAGNOSIS



1. TORQUE FITTING TO 27 N·m (20 FT. LBS.). IF LEAKAGE PERSISTS, REPLACE "O" RING SEAL. IF LEAKAGE IS DUE TO DAMAGED THREADS, REPAIR FITTING NUT OR REPLACE LINE AS REQUIRED. IF HOUSING THREADS ARE BADLY DAMAGED, REPLACE HOUSING.
2. REPLACE DUST AND STUB SHAFT SEALS.
3. IF LEAKAGE IS OBSERVED BETWEEN TORSION BAR AND STUB SHAFT, REPLACE THE VALVE ASSEMBLY.
4. IF LEAKAGE IS OBSERVED AT DRIVER SIDE AND IS NOT AFFECTED BY THE DIRECTION OF TURN, REPLACE PINION SHAFT SEAL.
5. IF LEAKAGE IS OBSERVED AT THE HOUSING END AND SPURTS WHEN BOTTOMED IN LEFT TURN, REPLACE INNER RACK SEAL.
6. REPLACE INNER RACK SEAL.
7. IF LEAKAGE IS OBSERVED AT PASSENGER SIDE, IT IS NECESSARY TO REMOVE BULKHEAD AND REPLACE BOTH "O" RING SEALS AND LIP SEAL.

Figure 3-2 Gear External Leak Diagnosis

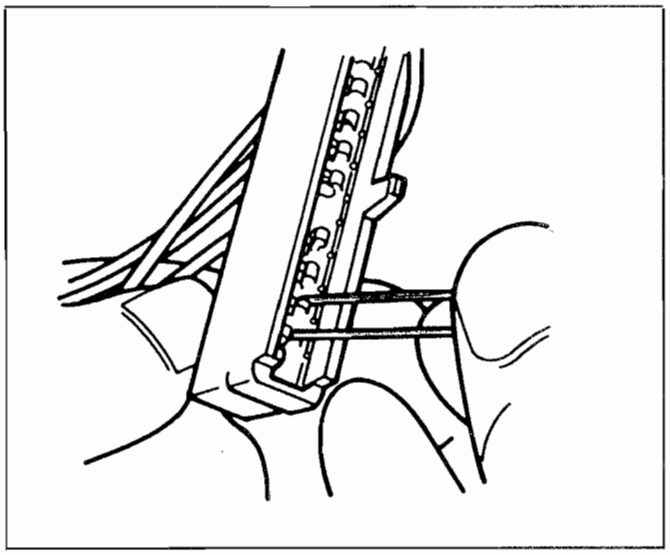


Figure 3-3 Check Chassis Connector

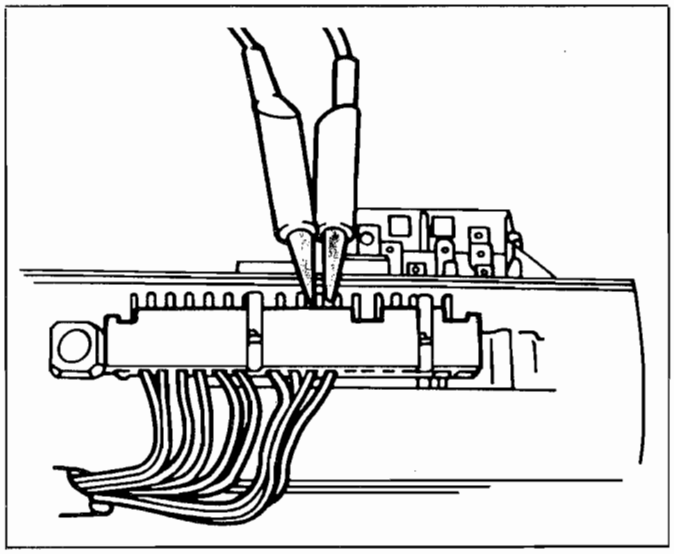


Figure 3-4 Check Switch Connector

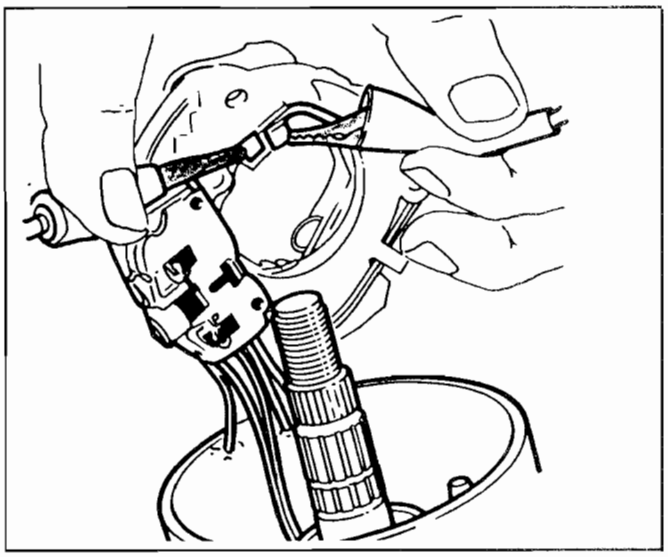


Figure 3-5 Check Switch Pads

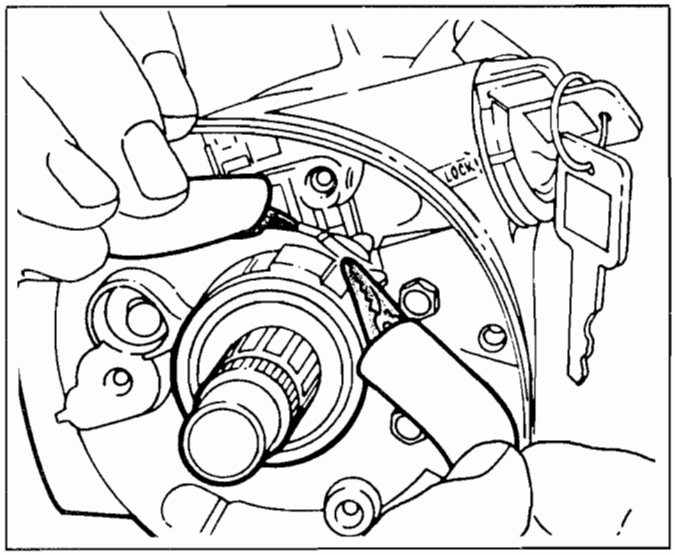


Figure 3-6 Check Switch

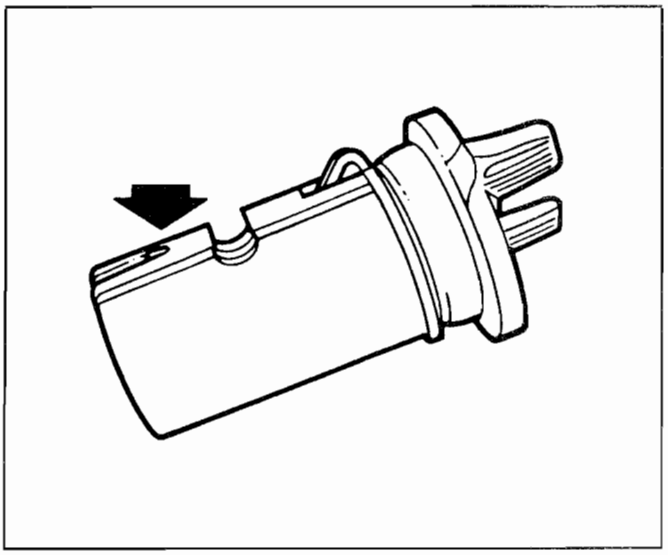


Figure 3-7 Lock Cylinder Actuator-No Key

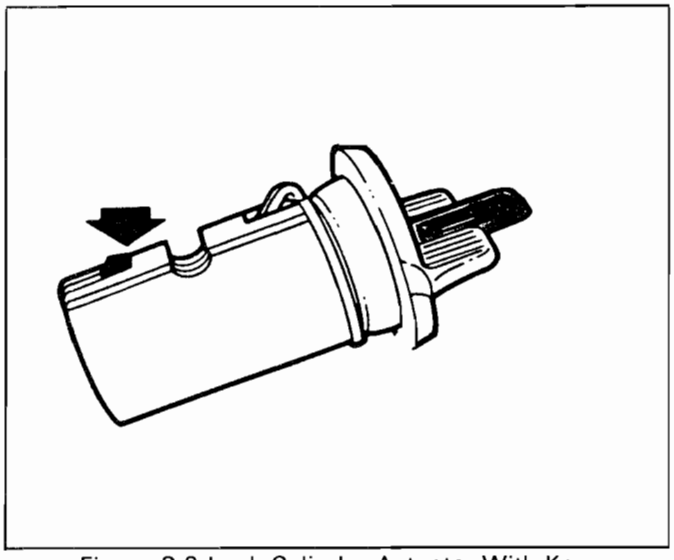


Figure 3-8 Lock Cylinder Actuator-With Key

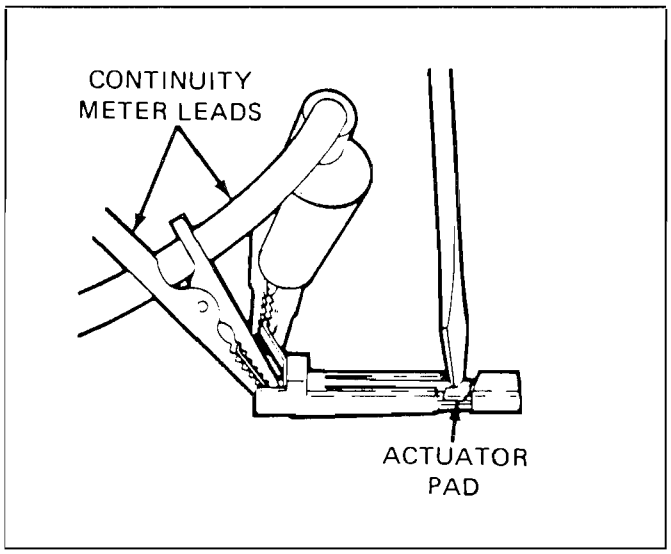


Figure 3-9 Check Buzzer Switch

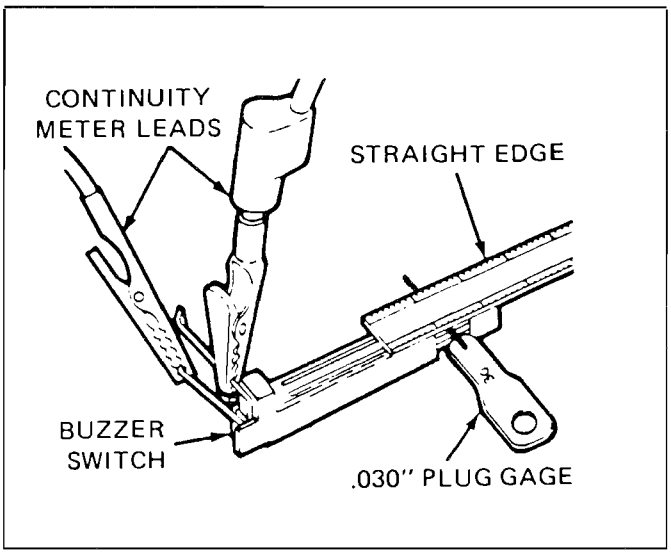


Figure 3-10 Contact Gap

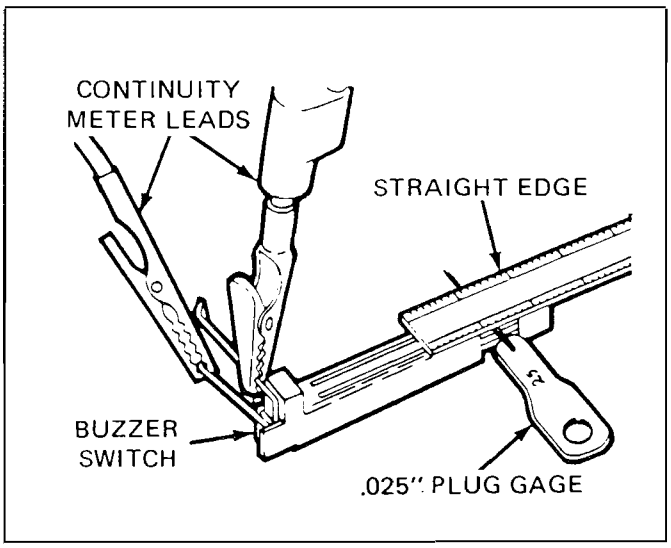


Figure 3-11 Set Low Limit

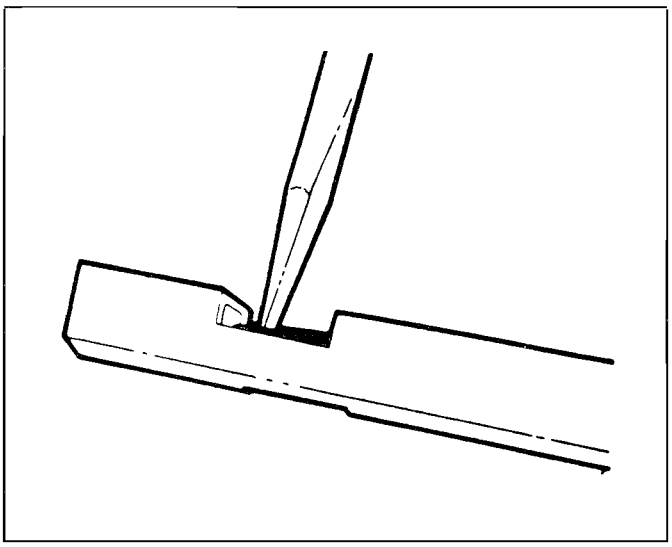


Figure 3-12 Decrease Gap

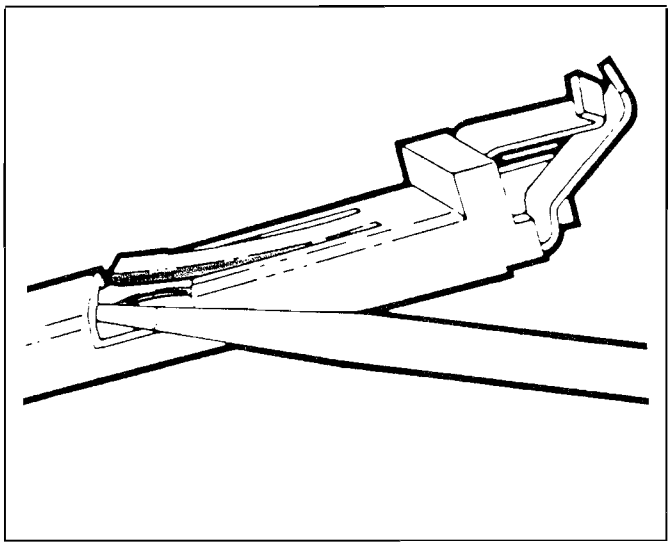


Figure 3-13 Increase Gap

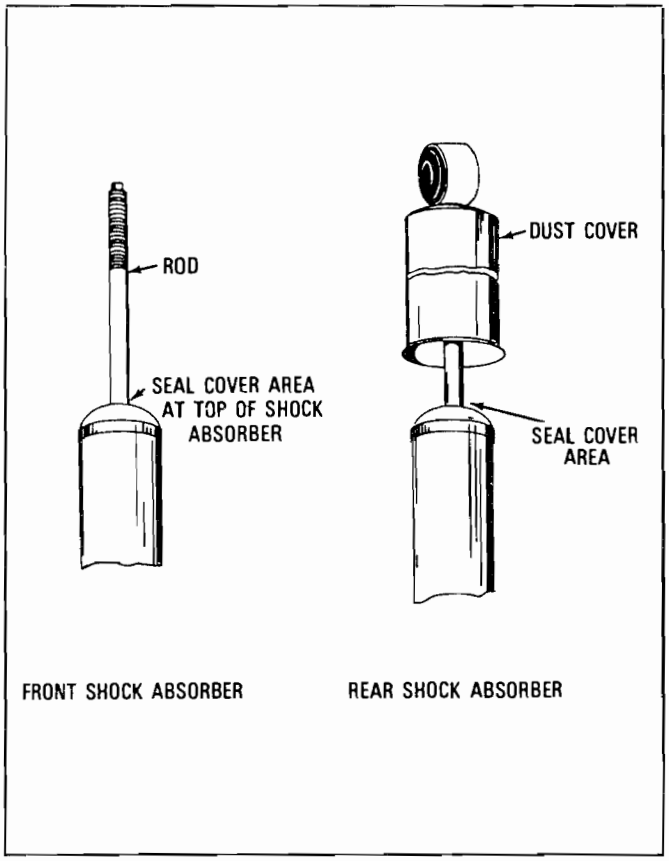


Figure 3-14 Shock Leak Check

SEALED WHEEL BEARING DIAGNOSIS

WHEEL BEARING ASSEMBLY NOISE DIAGNOSIS

If a Road Test indicates noise, it could be wheels, bearings or tires, check the following:

1. Check tires for proper pressure and uneven wear.
2. Raise car on a hoist and spin wheels; check for out-of-round tires, out-of-balance tires, bent rims, loose and/or rough wheel bearings.

- SUSPECT BEARING NOISE
  - FRONT WHEEL BEARING ASSEMBLY
    - Hoist Car and Support Lower Control and Spin Wheel with Engine.
  - REAR WHEEL BEARING ASSEMBLY
    - Hoist Car Spin Wheel with Wheel Spinner

CAUTION: On front wheel drive cars drive wheel spin should be limited to 35 MPH as indicated on the speedometer. This limit is necessary because the speedometer only indicates one-half on the actual wheel speed when one drive wheel is spinning and the other drive wheel is stopped. Unless care is taken in limiting drive wheel spin, the spinning wheel can reach excessive speeds. This can result in possible tire disintegration or differential failure, which could cause serious personal injury or extensive car damage.

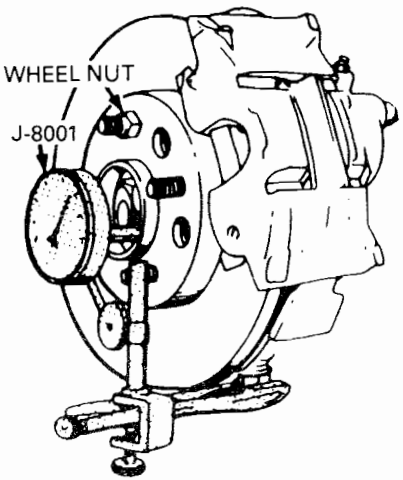
- NOISE OR ROUGHNESS CAN BE HEARD FROM DRIVER'S SEAT
  - Replace hub and bearing assembly
- NOISE OR ROUGHNESS CAN BE HEARD FROM DRIVER'S SEAT
  - Replace hub and bearing assembly
- NOISE OR ROUGHNESS CANNOT BE HEARD
  - Noise is not Wheel Bearing Assembly

- OTHER NOISE (CORRECT AS REQUIRED)

WHEEL BEARING ASSEMBLY LOOSENESS DIAGNOSIS

Free the shoes from the disc, or remove calipers.
Reinstall 2 wheel nuts to secure disc to bearing.
Mount dial indicator as shown below.
Grasp disc and use a push-pull movement.

If looseness exceeds .1270 mm (.005"). Replace hub and bearing assembly.



EXAMPLE OF MOUNTING DIAL INDICATOR

Figure 3-15 Sealed Wheel Bearing Diagnosis

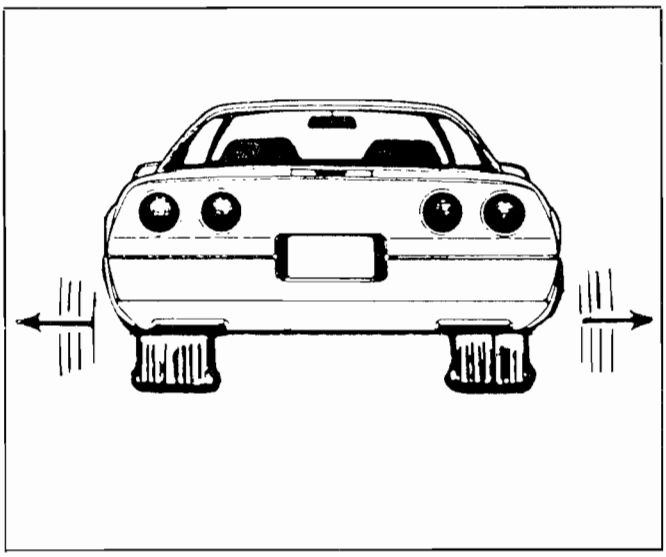


Figure 3-16 Radial Tire Waddle

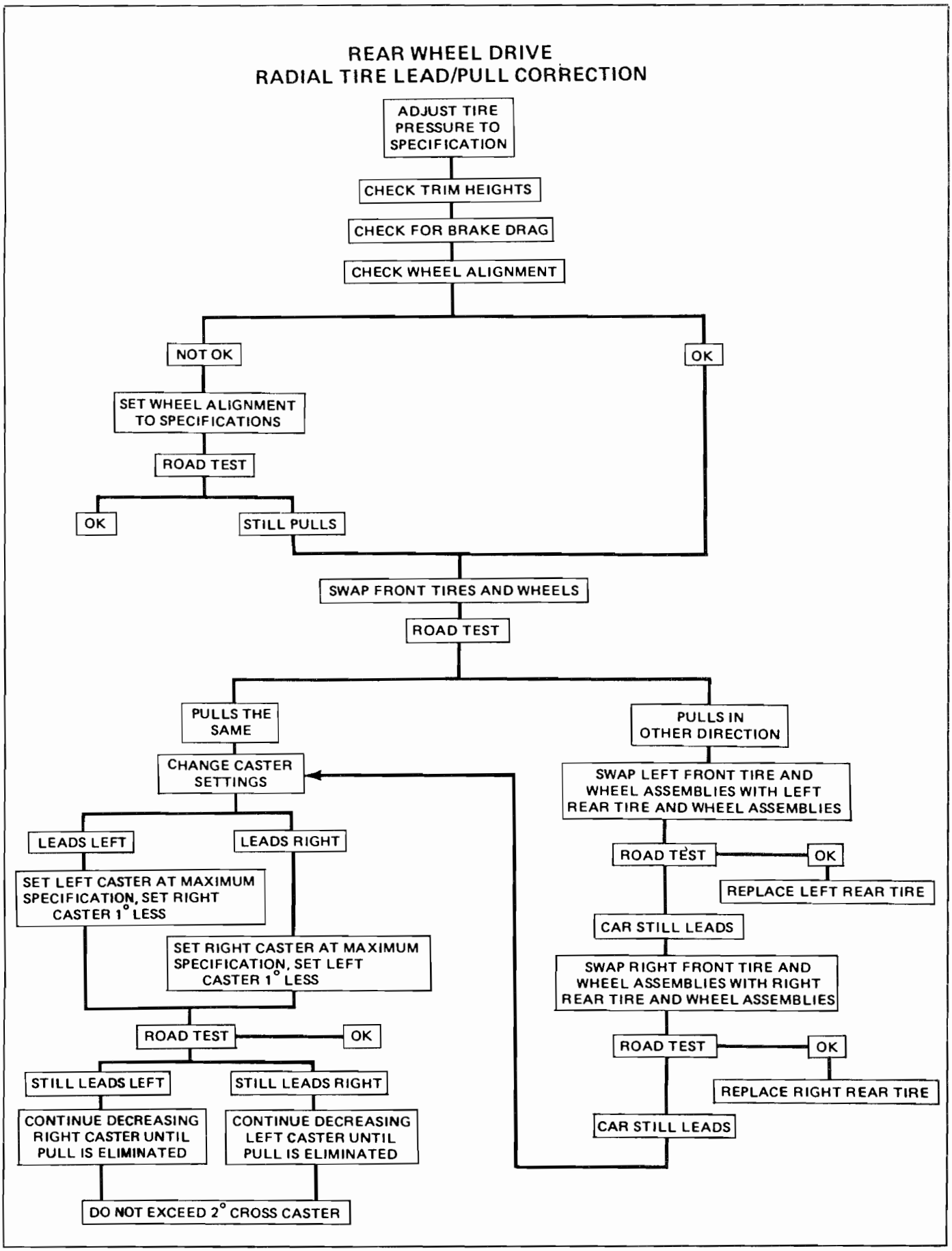


Figure 3-17 Lead Diagnosis

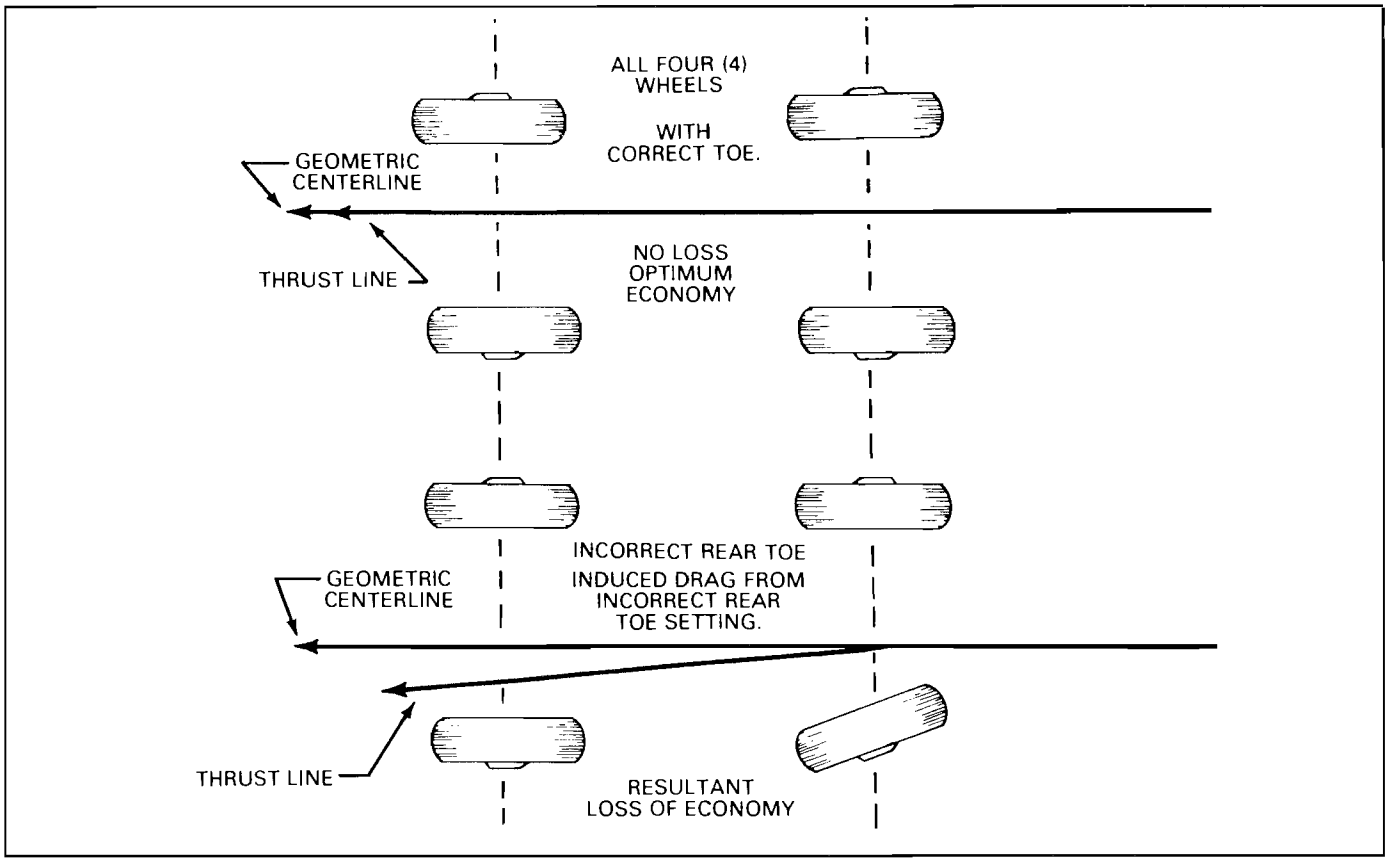


Figure 3-18 Four (4) Wheel Alignment

WHEEL RUNOUT SPECIFICATIONS

	Steel Wheels	Aluminum Wheels
Radial Runout	.040"	.030"
Lateral Runout	.045"	.030"

Figure 3-19 Wheel Runout Specifications

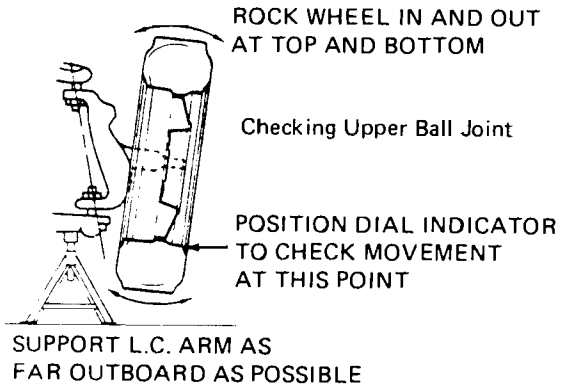


Figure 3-20 Ball Joint Check

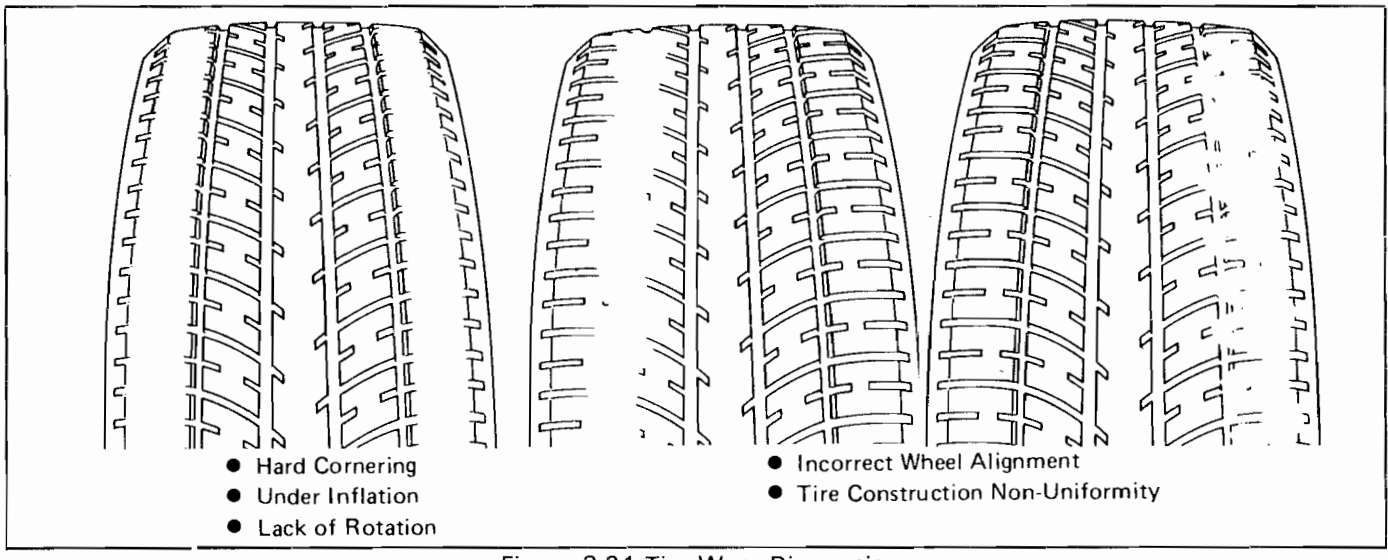


Figure 3-21 Tire Wear Diagnosis

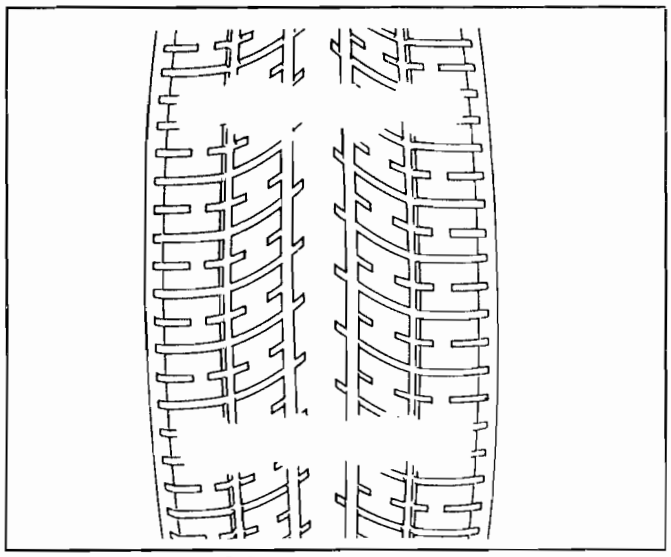
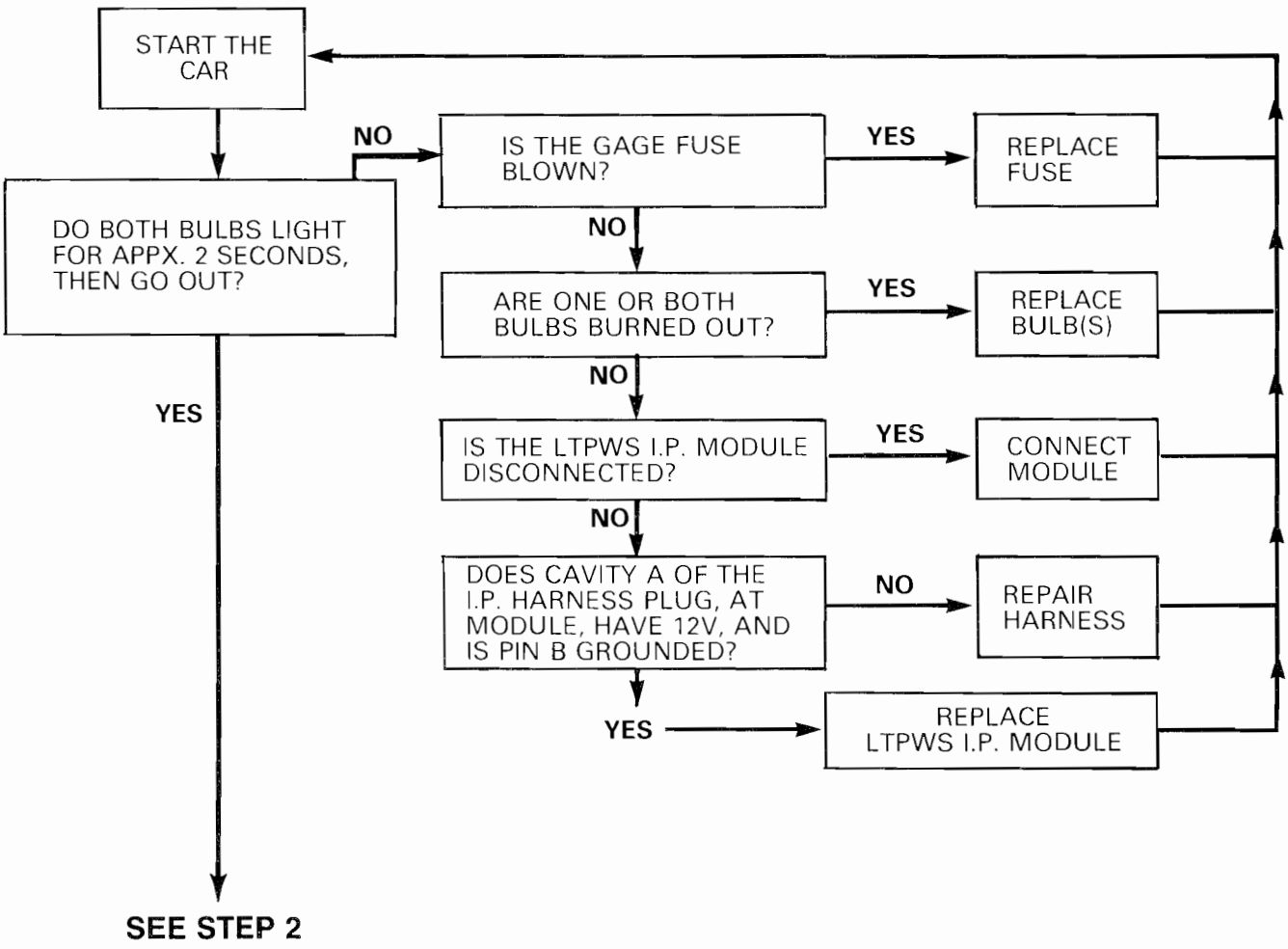


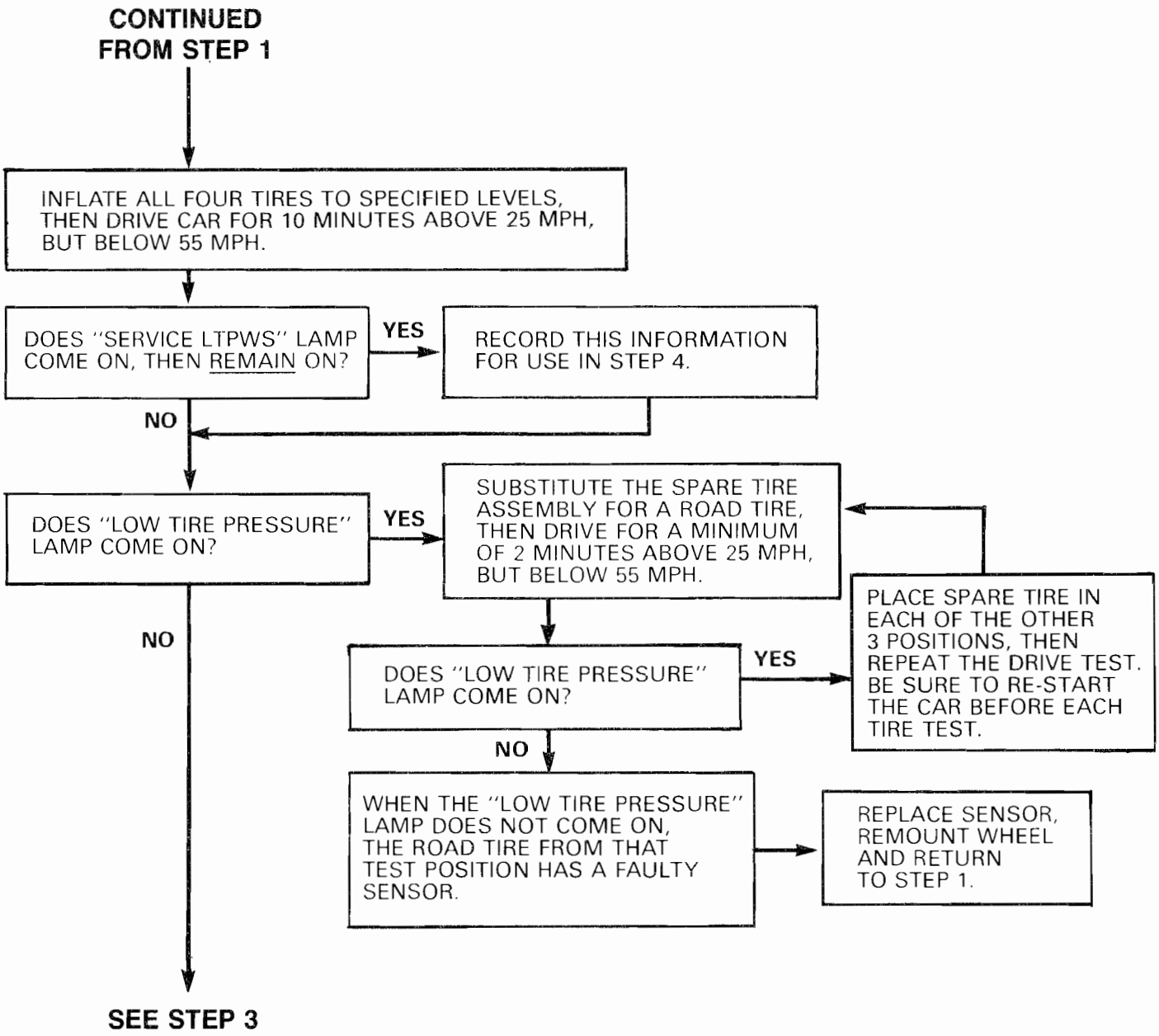
Figure 3-22 Tire Wear Indicators

CORVETTE LOW TIRE PRESSURE WARNING SYSTEM (LTPWS) DIAGNOSIS STEP 1 MODULE TEST



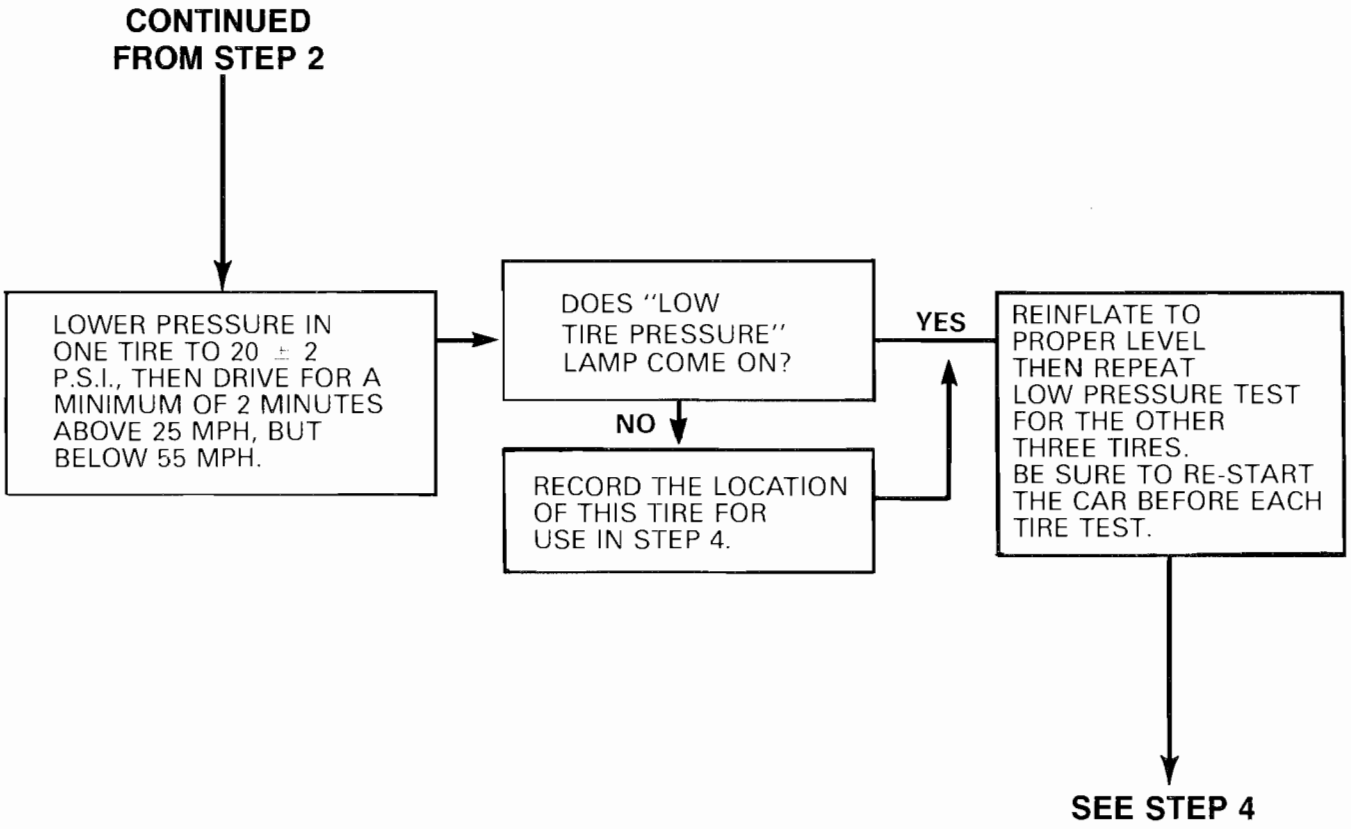
STEP 2 ⟶

CORVETTE LTPWS DIAGNOSIS STEP 2 NORMAL TIRE PRESSURE TEST



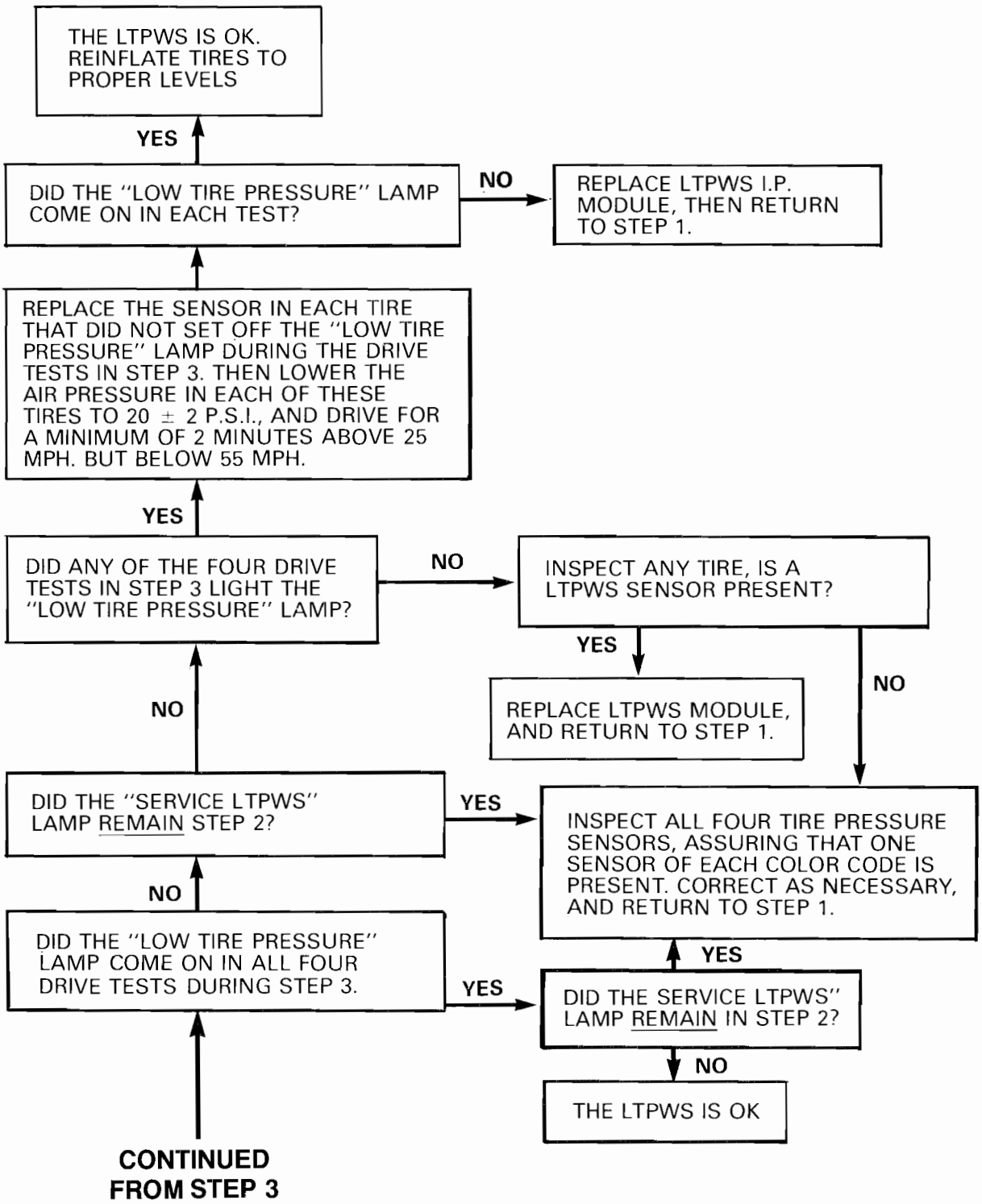
STEP 3 ⟶

CORVETTE LTFWS DIAGNOSIS
STEP 3
LOW TIRE PRESSURE TEST



STEP 4 ⟶

CORVETTE LTPWS DIAGNOSIS STEP 4 CORRECTIVE ACTIONS (START FROM BOTTOM OF CHART)



SECTION 3A

WHEEL ALIGNMENT

NOTICE: All wheel alignment fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts. For prevailing torque nut(s) and bolt(s), refer to "Reuse of Prevailing Torque Nut(s) and Bolt(s)" chart in Section 0A.

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Rear Wheel Alignment Specifications 3A-10
Conversion Chart 3A-11

GENERAL INFORMATION

The complete suspension system (front and rear) and the steering geometry are designed to provide a neutral (straight ahead) directional sense, and to guide the vehicle safely and with minimum tire wear.

Satisfactory vehicle operation may occur over a wide range of suspension alignment angles. Should the alignment vary beyond the specified limits, re-adjustment is advisable. The specifications stated in this section should be used by owners, dealers and alignment specialists as a guideline in vehicle diagnosis, either for repairs under new vehicle warranty, or for maintenance service. These specifications provide a safe, all around operating range between all (4) four wheels, the suspension attaching components, and the ground.

CASTER ANGLE

(Figure 3A-1)

Caster is the forward or rearward tilting of the wheel axis (at the top) from vertical. A rearward tilt (at the top) is a positive angle, and a forward tilt is a negative angle.

Weak springs or overloading of a vehicle will affect caster, because the steering axis changes when normal body "trim height" is altered.

Caster angle influences directional stability and steering effort, but does not affect tire wear.

CAMBER ANGLE

(Figure 3A-1)

Camber is the inward or outward tilting (angle) of the wheels from the vertical when viewed from the front or rear of the car. When the wheels tilt outward (at the top), the camber is "positive" (+). When the wheels tilt inward (at the top), the camber is "negative" (–). The amount of tilt is measured in degrees from the vertical. This measurement is camber angle. Camber on the front wheel drive vehicles is designed much closer to 0°. Camber adjustment is available at the front wheels.

The camber setting influences both directional control and tire wear.

STEERING AXIS INCLINATION ANGLE

Steering Axis Inclination (S.A.I.) is the inward tilt (angle) at the top of the steering knuckle from vertical. The inclination angle is the angle between true vertical and a line through the center of the strut and lower ball joint - as viewed from the front of the vehicle. The S.A.I. on front wheel drive vehicles is generally negative.

INCLUDED ANGLE

The Included Angle is the angle measured from the camber angle to the line through the center of the strut and lower ball joint, as viewed from the front of the vehicle.

SCRUB RADIUS

The Scrub Radius is the distance between the line through the center of the strut and the lower ball joint to the road surface, and the actual 0° or true vertical. The scrub radius for front wheel drive vehicles should be less positive or slightly negative.

TOE-OUT ON TURNS

Toe-out on turns refers to the difference in the angle between the front wheels and the vehicle center

line during turns. Each wheel spindle moves in an arc, above and below the horizonal reference. This arc is dependent on all three (3)angles - toe, camber and caster.

SET BACK

Set Back is the length that one front wheel may be rearward of the other front wheel. Set back may be caused by a road hazzard or collision.

TURNING ANGLE

The angle of each front wheel, when a vehicle changes direction, is unique to its own radius. Each wheel is following a dependent path, and requires its own geometry.

TOE ANGLE

Toe is the dimension which allows parallel rolling of all four (4) wheels. As the vehicle is directed down the highway, the components which make-up the steering and suspensions are subjected to dynamic forces. Manufacturing tolerances exist in each complementary component, which when compounded, requires pre-compensation (toe-in/toe-out). Precise toe-in or toe-out will provide minimal tire wear and optimum economy.

PRELIMINARY INSPECTIONS PRIOR TO CHECKING ALL FOUR (4) WHEELS AND THEIR RELATIONSHIP

Steering and vibration complaints are not always the result of improper alignment. Other possibilities are bent wheels, imbalance of wheel and tire, and "lead" due to worn or improperly manufactured tires. "Lead" is the car's deviation from a straight path on a level road without pressure on the steering wheel. See Section 3 for the procedure to determine if there is a tire lead problem.

Before making any adjustment affecting wheel alignment, make the following inspections to ensure correct alignment readings and alignment adjustments.

Check:

- All tires for proper inflation pressures also check that tires have about the same tread wear
- Hub and bearing assemblies for excessive wear; correct if necessary
- Ball joints and tie rod ends; if they are loose, correct them before adjusting
- Run-out of wheels and tires (bent wheels/faulty tires)
- Car trim height; if out of limits and a correction is to be made, do so before adjusting alignment.
- Control arms for loose bushings
- Stabilizer shaft for loose or missing parts
- Suspension and steering components for damage, and replace parts as necessary

Consideration must be given to excess loads, such as tool boxes, sample cases and even to heavy passengers. If these extra loads are normally carried in the car, they should remain in the car during alignment adjustments. Consideration should also be given to the condition of the equipment being used to adjust alignment. Be sure to follow the equipment manufacturer's instructions. Regardless of the equipment used to adjust alignment, the car must be on a level surface, both fore-and-aft and sideways.

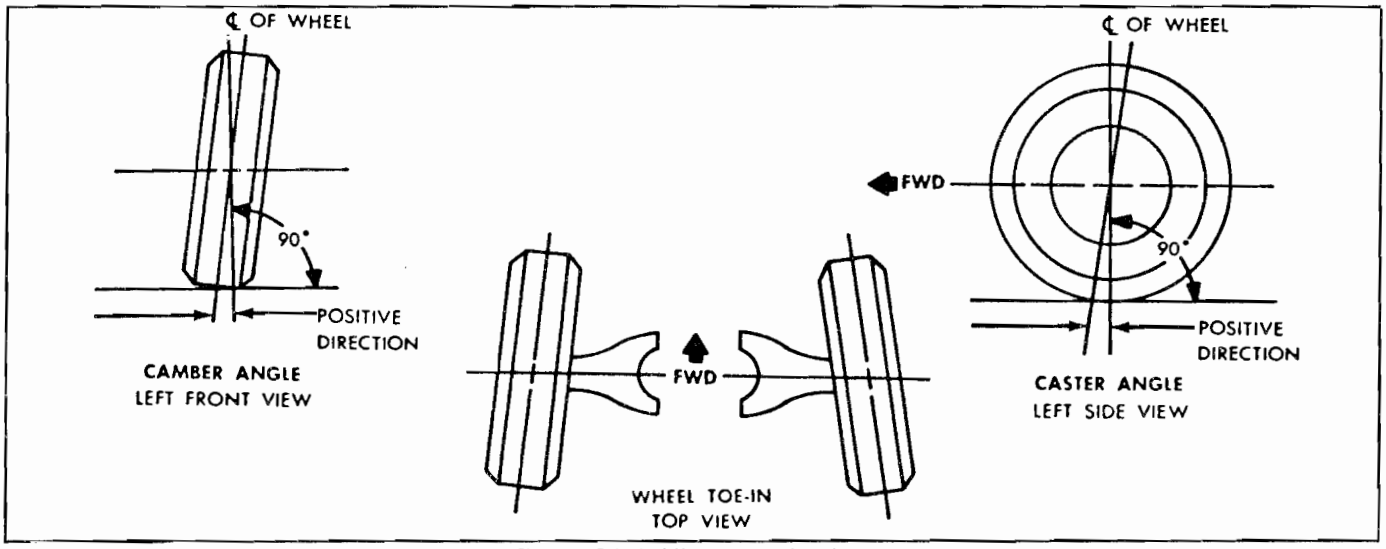


Figure 3A-1 Alignment Angles

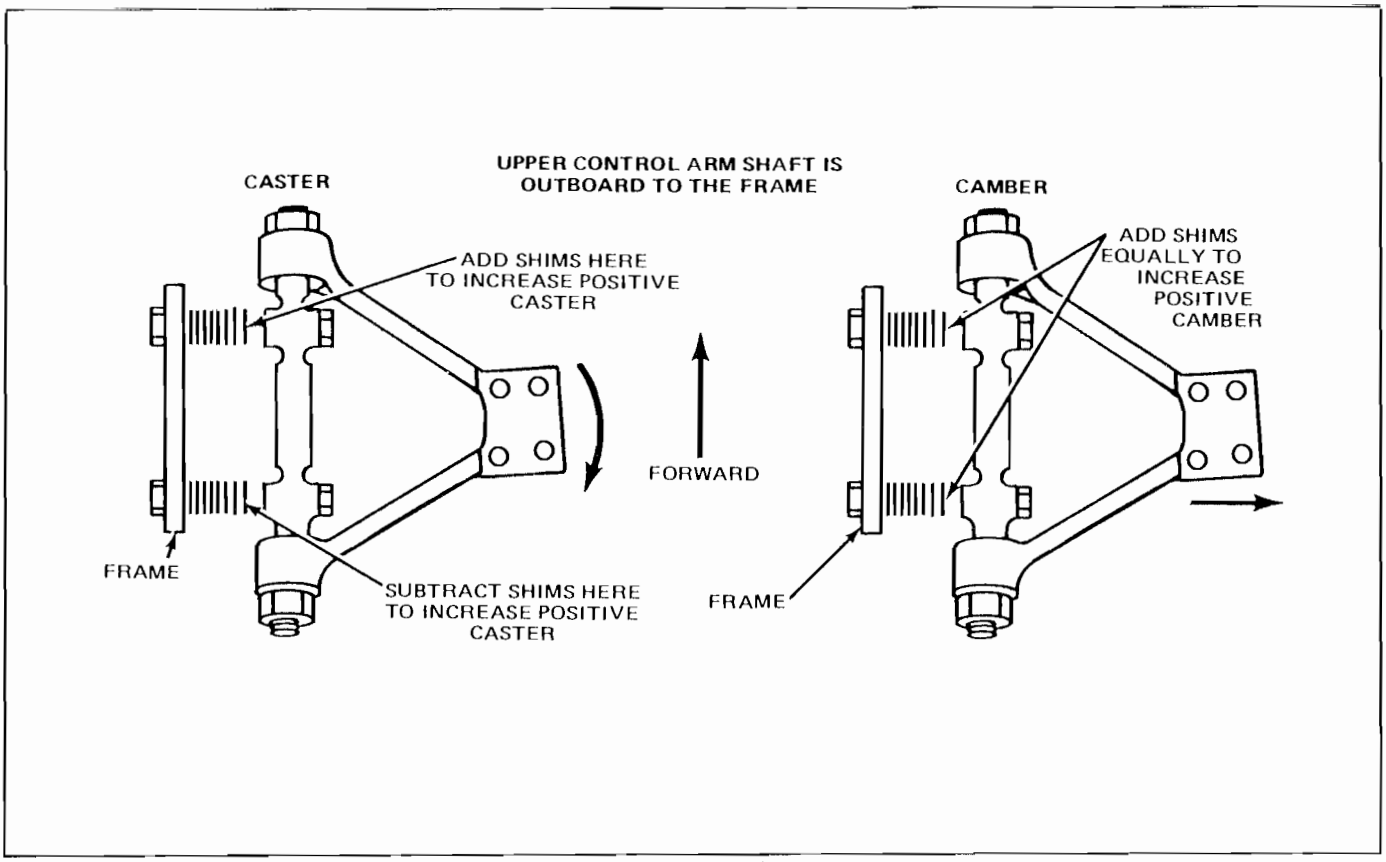


Figure 3A-2 Front Wheel Caster/Camber Adjustment

ON-CAR SERVICE

FRONT-WHEEL ALIGNMENT

Front Alignment Angles-Check:

Install alignment equipment following equipment manufacturer's instructions. Measure alignment angles and record the readings. If adjustments are necessary, make them in the following order:

- Jounce front and rear bumpers 3 times to normalize suspension prior

Camber/Caster Angle Adjustment

(Figure 3A-2)

Before adjusting caster and camber angles, both the front and rear bumpers should be raised and released (jounced) three times each. See "Trim Heights" in this section. NOTE: When changing shims, open the hood. Close the hood when checking alignment settings.

Caster and camber adjustments are made by means of shims inserted between the upper control arm shaft and the frame bracket, shown in Figure 3A-2. Shims may be added, subtracted or transferred to change the readings as follows:

1. CASTER - Transfer shims, front to rear or rear to front.

   The transfer of one shim .79mm (0.03 inch) from the rear bolt to the front bolt will increase the positive caster (approx. .36°). NOTE: Rear caster is not adjustable.

2. CAMBER: FRONT SUSPENSION - Change shims at both the front and rear of the shaft.

Caster and camber can be adjusted in one operation (front). Toe must be checked AFTER changing camber or caster.

To adjust caster and camber, loosen the upper control arm shaft to frame nuts, add or substract shims as required, per alignment correction charts, and retorque nuts (front).

Caster, camber and toe specifications will be found in Figure 3A-9.

A normal shim pack will leave at least two (2) threads of the bolt exposed beyond the nut. The difference between front and rear shim packs must not exceed 9.5mm (.38 inch).

If these requirements cannot be met in order to reach specifications, check for damaged suspension members.

Always tighten the nut on the thinner shim pack first. This provides improved shaft to frame clamping and torque retention. Torque to 85 N·m (63 ft. lbs.).

3. CAMBER: REAR SUSPENSION - Rotate the cams located at the inner end of the lateral strut. To adjust camber on the rear suspension, hold the bolt head, loosen the cam nut. Rotate the cam to obtain required specification and torque the cam nut. See Figure 3A-10.

Front Toe Angle Adjustment

(Figure 3A-3)

1. Loosen lock nut on inner tie rods.
2. Adjust toe to specification by turning inner tie rods.
2. Check boot seals that they are not twisted.
3. Torque lock nuts to: 70 N·m (50 FT. LBS.)

Rear Toe Angle Adjustment

Always follow equipment manufacturer's instructions.

1. Loosen lock nut on the tie rod.
2. Rotate tie rod at the serrated area of the rod to obtain the specified toe.
3. Tighten lock nut on rod. Torque nut to 63 N·m (46 FT. LBS.).

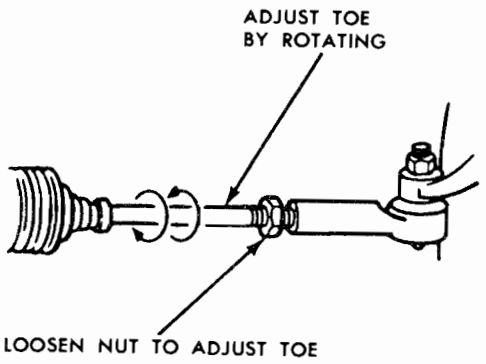
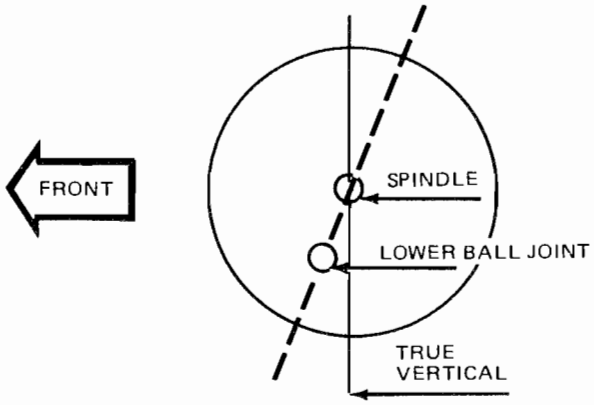
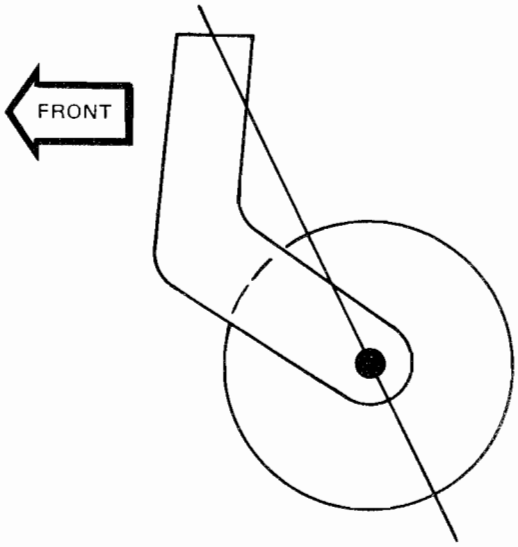


Figure 3A-3 Toe Adjustment

CASTER

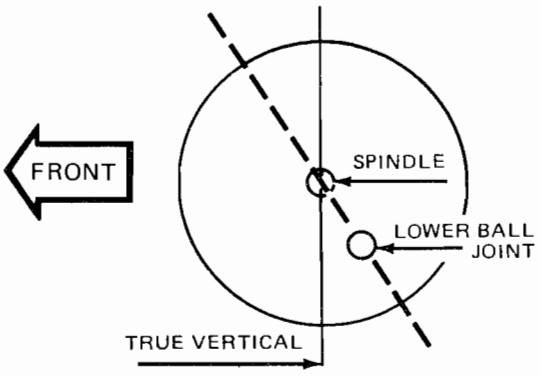


CASTER IS POSITIVE WHEN THE LOAD (LOWER BALL JOINT) IS AHEAD OR PULLING THE SPINDLE.

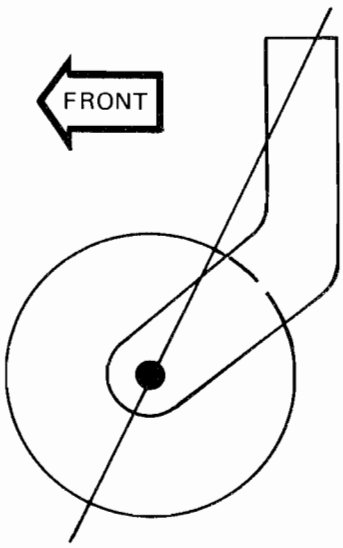


LOAD IS PULLING THE WHEEL.

IT IS IMPORTANT TO KEEP THE BODY AT IT'S DESIGNED HEIGHT. OVERLOADING THE VEHICLE OR HAVING A WEAK OR SAGGING REAR SPRING WILL AFFECT CASTER. WHEN THE REAR OF THE VEHICLE IS LOWER THAN IT'S NORMALLY DESIGNED HEIGHT, THE FRONT SUSPENSION MOVES TO A MORE POSITIVE CASTER. IF THE REAR OF THE VEHICLE IS HIGHER THAN IT'S NORMALLY DESIGNED HEIGHT, THE FRONT SUSPENSION MOVES TO A LESS POSITIVE CASTER.



CASTER IS NEGATIVE WHEN THE LOAD (LOWER BALL JOINT) IS BEHIND OR PUSHING THE SPINDLE.

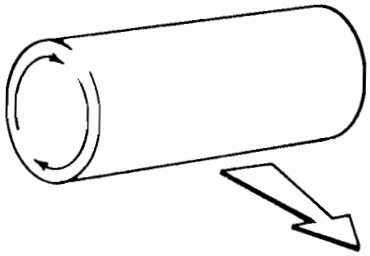


LOAD IS PUSHING THE WHEEL.

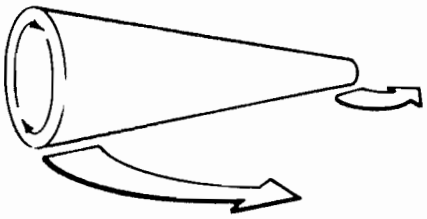
Figure 3A-4 Caster Angle

CAMBER

SHAPES AND THEIR ROLLING PATHS.

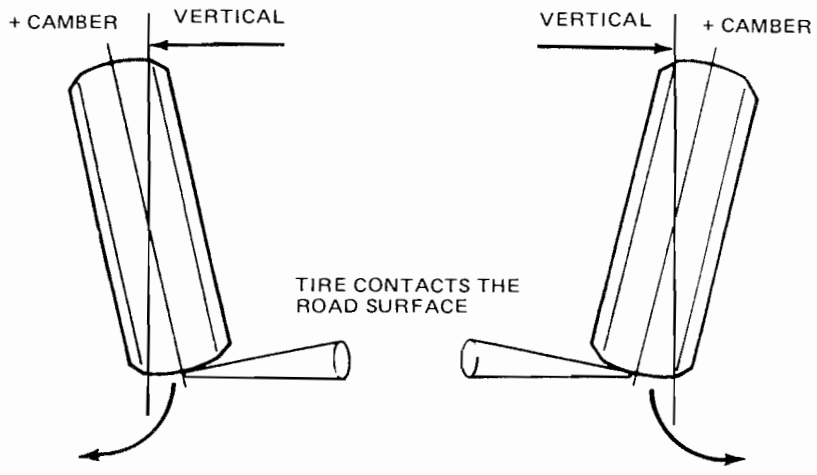


A CYLINDER WILL ROLL STRAIGHT AHEAD



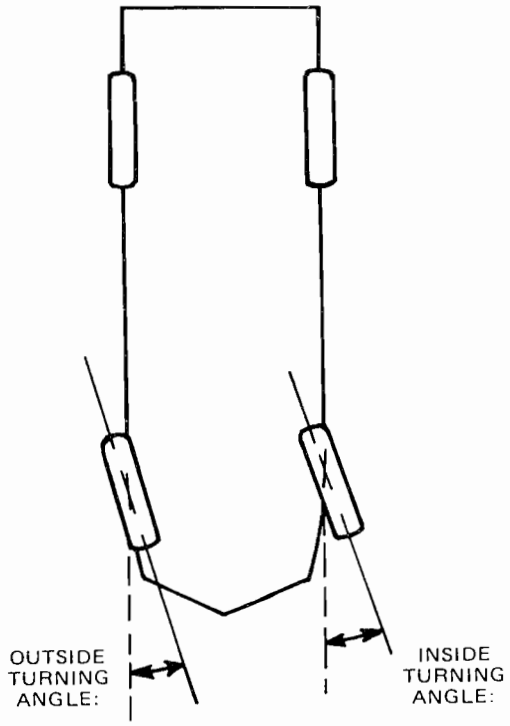
A CONE WILL ROLL IN A CIRCLE TOWARD THE SMALL END

WHEN WHEELS ARE SET TO A POSITIVE CAMBER THEY WILL TEND TO ROLL IN A PATH AWAY FROM THE VEHICLES TRUE PATH. THE EFFECT OF EACH WHEEL TENDS TO CANCEL THE OTHER.



THE SUSPENSION GEOMETRY AND CAMBER SETTING ARE DESIGNED TO KEEP THE TIRE TREAD FLAT ON THE ROAD THRU BUMPS AND DIPS.

Figure 3A-5 Camber Angles



TURNING ANGLES/TOE-OUT

These angles are part of the steering geometry necessary to promote smooth turning and keep tire wear to a minimum.

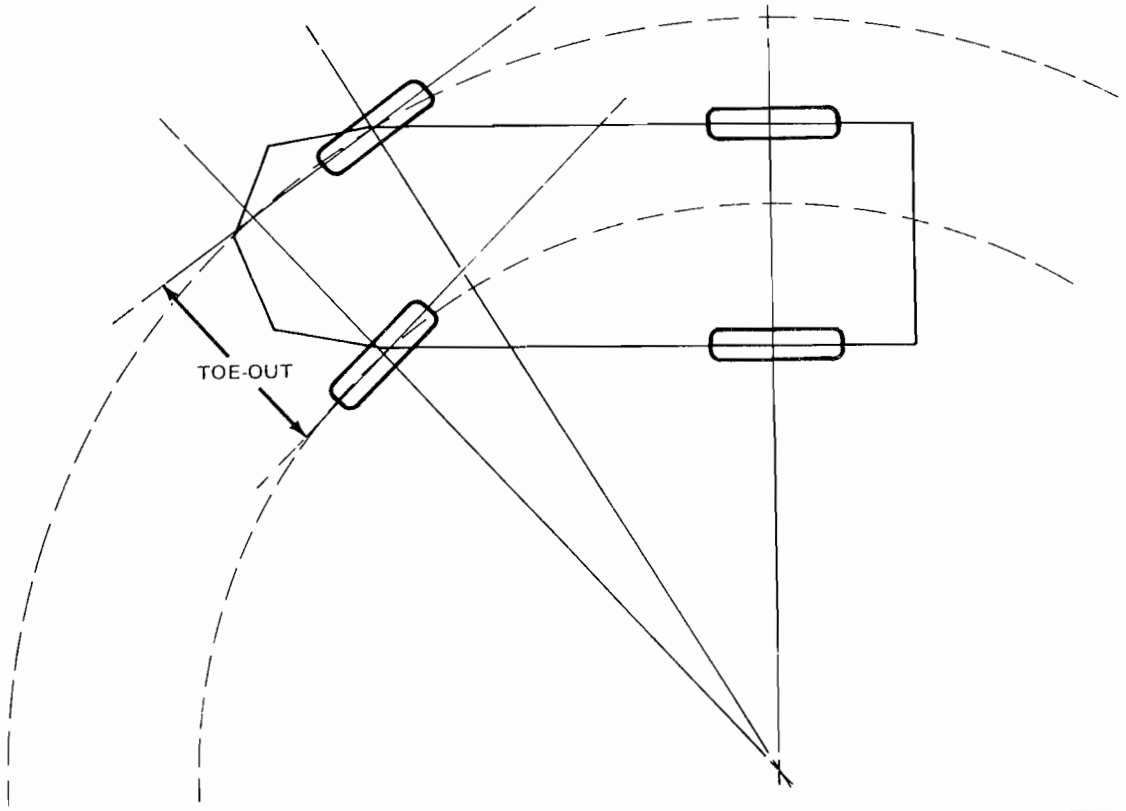
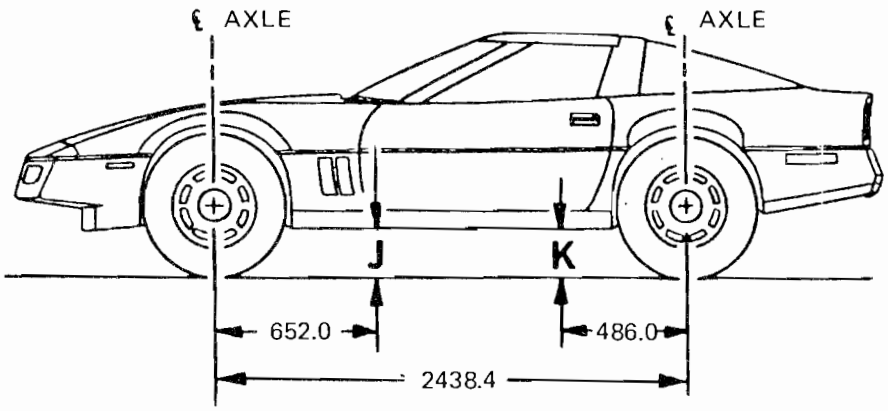
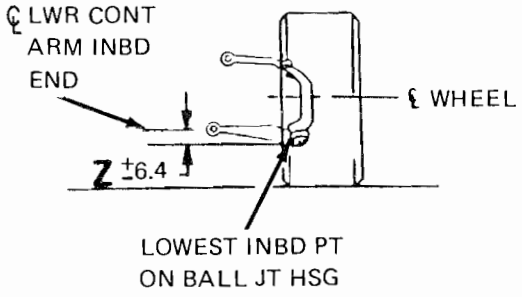


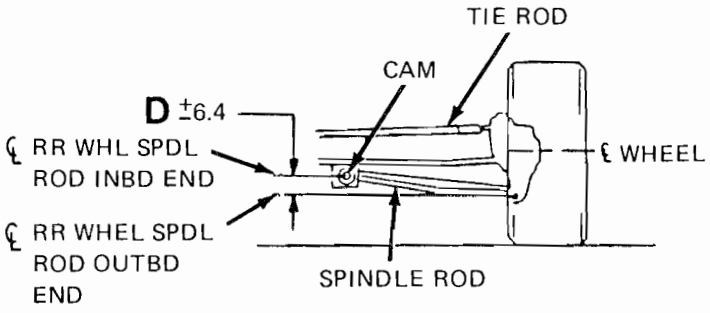
Figure 3A-6 Turning Angles

TRIM HEIGHTS SPECIFICATIONS





FRONT SUSPENSION



REAR SUSPENSION

			Z		D		J		K	
MODEL	TIRE	SUSP	SHIPPED	CURB	SHIPPED	CURB	SHIPPED	CURB	SHIPPED	CURB
YA00	P255-50VR16	STD	46.4	49.2	92.7	80.2	191.7	190.3	205.0	194.6
YA00	P255-50VR16	FE7	52.2	54.6	87.3	77.6	194.5	193.5	201.8	193.6

NOTE: All dimensions in mm.

Dimension "Z", "J", "K" and "D" . . . Vertical to ground and apply to all vehicles.

Vertical heights: "Z" and "J" dimensions- lift front bumper of vehicle up approx 38.0. Gently remove hands and let vehicle settle on its own. Repeat twice for a total of 3 times. Measure "Z" and "J" dimensions. Push front bumper of vehicle down approx 38.0. Gently remove hands and let vehicle rise on its own. Repeat twice for a total of 3 times. Measure "Z" and "J" dimensions. True heights are the average of the high and low measurements.

"D" & "K" dimensions - same procedure as "Z" and "J" dimensions.

Recommended tire pressure: Trim height. Set tire pressure to agree with vehicle's tire pressure sticker for loading "up to vehicle capacity".

NOTE: Loading Conditions: Shipping weight- vehicle is built to parts list specs. including coolant to capacity and four (4) gallons of gasoline. Curb weight- vehicle is built to parts list specs. including coolant to capacity and full tank of gasoline.

Figure 3A-8 Trim Height Specifications

FRONT WHEEL ALIGNMENT SPECS (CURB E)

VEHICLE	OPERATION	SERVICE CHECKING	SERVICE SETTING
Y CAR	CASTER	+6° ± .8° (C)	+6° ± .5° (B)
	CAMBER	+.8° ± .5° (C)	+.8° (B)
	TOE (FRONT)	0° ± .15° (D)	0° (D)

NOTE Vehicle must be jounced 3 times before checking alignment to eliminate false geometry readings.

Front suspension (Z) dimension and rear suspension (D) dimension are held as indicated in Fig. 3A-6.

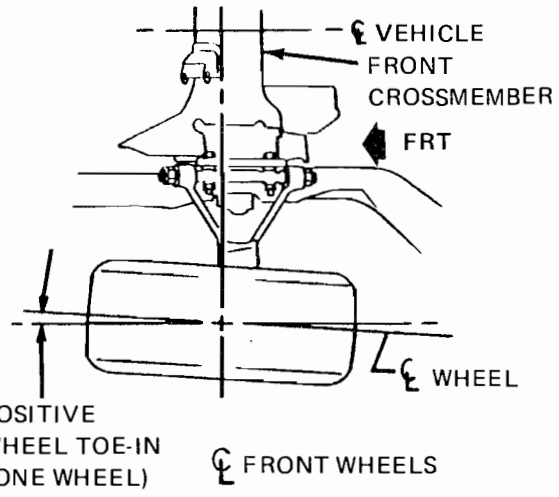
Wheel alignment specifications to be as indicated on this chart.

(B) Left and right side to be equal within .50°.

(C) Left and right side to be equal within 1.0°.

(D) Toe-in left and right side to be set separately per wheel and steering wheel reference lines must be held parallel with instrument cluster reference lines within ± 1.0°.

(E) Loading condition includes coolant to capacity and full tank of fuel.



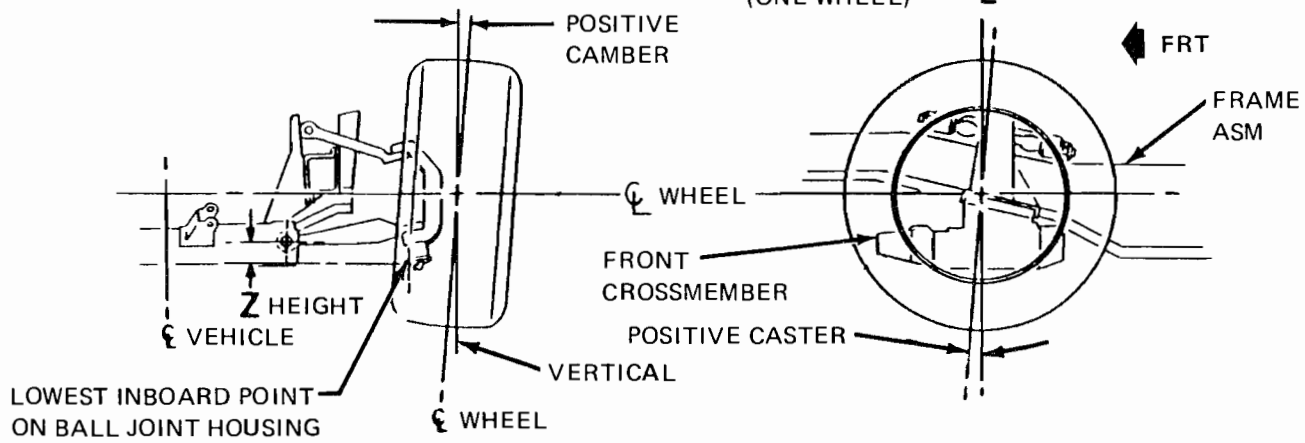


Figure 3A-9 Front Wheel Alignment Specifications

REAR WHEEL ALIGNMENT SPECS (CURB A)

VEHICLE	OPERATION	SERVICE SETTING
Y CAR	CAMBER	+ .4° ± .5°
	TOE DEG/WHEEL	0° ± .2°

CAMBER

(1) Finger tighten lateral strut attaching parts at inboard end of strut asm.
(2) Rotate cam to obtain specified camber.
(3) Hold camber setting and torque nut with rear suspension set at "D" height of 83.6 mm. As shown in Fig. 3A-6.

TOE

(1) Loosen Lock Nut
(2) With special tool in serrated area, rotate tie rod to obtain specified toe
(3) Torque lock nut and adjust boot to cover lock nut & serrations
Thrust angle not to exceed .15°

CHECKING

NOTE Vehicle must be jounced three times before checking alignment, to eliminate false geometry readings.

(A) Loading condition includes coolant to capacity and full tank of fuel.

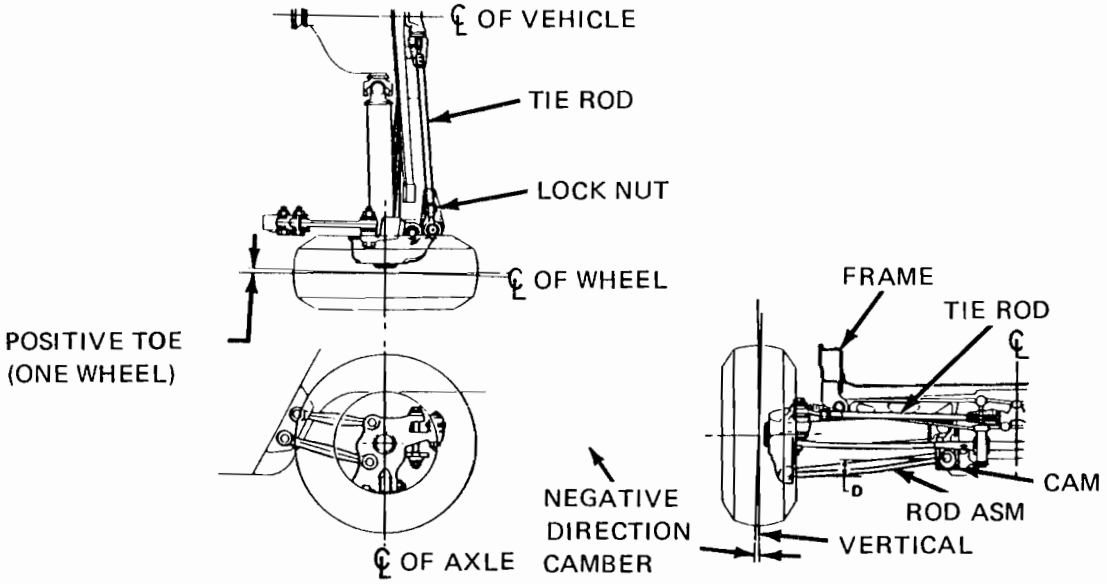
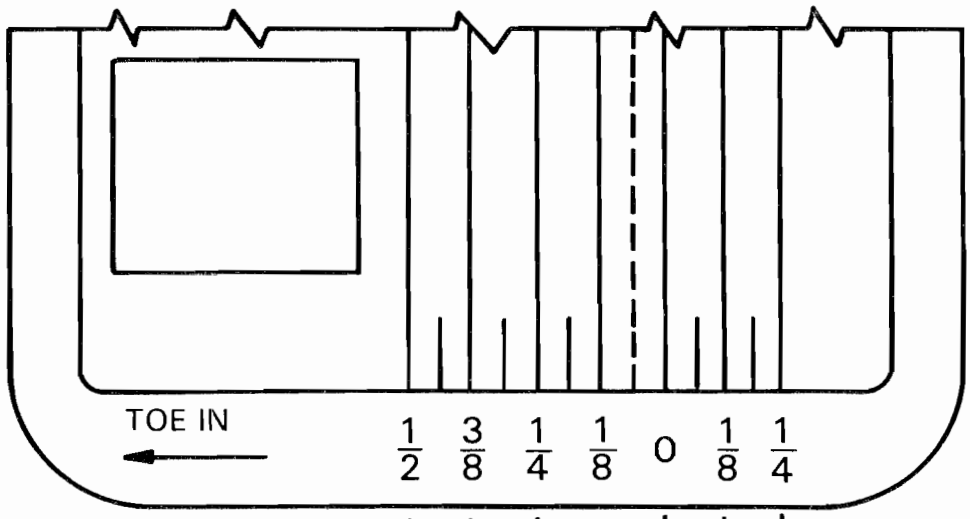
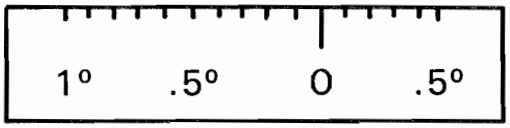


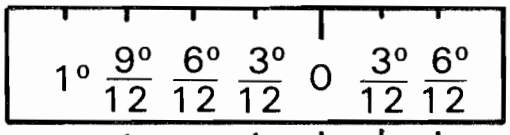
Figure 3A-10 Rear Wheel Alignment Specifications



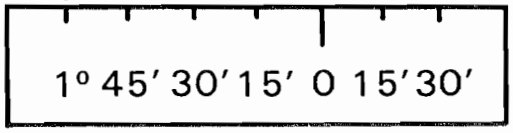
STANDARD SCREEN INDICATES TOE PER WHEEL IN INCHES.



INDICATES TOE PER WHEEL IN DEGREES & TENTHS.



INDICATES TOE PER WHEEL IN DEGREES & TWELFTHS.



INDICATES TOE PER WHEEL IN DEGREES & MINUTES. (60 MIN. = 1°)

Figure 3A-11 Geometric Conversion Chart

SECTION 3B5

STEERING COLUMN

NOTICE: The bolt and nut fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

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Remove/Install Intermediate Shaft 3B5-4
Remove/Install Steering Column 3B5-5
Lock Cylinder 3B5-6
Steering Column OH-A 3B5-7
Steering Column OH-B 3B5-8
Steering Column OH-C 3B5-9
Checking Column for Damage 3B5-10
Specifications 3B5-12
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GENERAL DESCRIPTION

The function locking energy absorbing steering column includes three important features in addition to the steering function:

1. The column is energy absorbing, designed to compress in a front-end collision to minimize the possibility of an injury to the driver of the car.
2. The ignition switch and lock are mounted conveniently on this column.
3. With the column mounted lock, the ignition and steering operations can be locked to inhibit theft of the car.

The turn signal lever provides for control of headlight beams, curise control, and windshield washer and wiper.

This column may be easily disassembled and reassembled. To insure the energy absorbing action, it is important that only the specified screws, bolts and nuts be used as designated and that they are tightened to the specified torque. When the column assembly is removed from the car, special care must be taken in handling it. Use of a steering wheel puller, other than the one recommended in this manual or a sharp blow on the end of the steering shaft, leaning on the assembly, or dropping the assembly, could shear or loosen the plastic fasteners which maintain column rigidity. A new key is used for theft deterrence.

Lubrication

Apply a thin coat of lithuim grease to all friction parts when reassembling.

1. **NUT**, Hex (M14 x 1.5)
2. **BUMPER**, Retr Strg Col
3. **SPACER**, Retr Strg Col
4. **RETAINER**, Snap Ring Horn Cnct Carr
5. **RETAINER**, Shaft Lk
6. **PLATE**, Shaft Lk
7. **CAM**, T/Sig Canc
8. **SPRING**, Upr Brg
9. **SCREW**, Sig Sw Mtg
10. **SCREW**, Rd Hd Torx Tap (M4.2 x 1.41 x 20)
11. **SWITCH**, Turn Sig
12. **SEAT**, Upr Brg Race
13. **RACE**, Upr Shf Upr Brg
14. **SCREW**, Hsg Cover
15. **SWITCH**, Ign Key Wrn Buzzer
16. **CLIP**, Buzzer Sw Ret
17. **SCREW**, Lock Ret
18. **COVER**, Lock Hsg
19. **LOCK ASM**, Ign (Coded w/Key)
20. **ACTUATOR**, Dimr Sw Rod
21. **CAP**, Col Hsg Cvr End
22. **PIVOT** Sw Actr
23. **PROTECTOR**, Wrg
24. **BEARING**, Upr Shf
25. **BOLT**, Shaft Lk
26. **SPRING**, Shf Lk Bolt
27. **SHOE**, Lock
28. **SHOE**, Lock
29. **SHAFT**, Ign Sw
30. **PIN**, Lk Shoe Ret
31. **PIN**, Pivot-Tilt
32. **SPRING**, Lk Shoe Rtn
33. **SPRING**, Lk Shoe Rel
34. **PIN**, Lk Shoe Rel Lvr
35. **LEVER**, Lk Shoe Rel
36. **RETAINER**, Spring
37. **SPRING**, Whl Tilt
38. **GUIDE**, Strg Whl Tilt Spr
39. **SCREW**, Lk Bolt Spr
40. **SECTOR**, Ign Sw Actr
41. **HOUSING**, Strg Col
42. **SPRING**, Ign Sw Rack
43. **RACK**, Ign Sw Actr
44. **SCREW**, Col Supt
45. **SUPPORT**, Col Hsg
46. **PIN**, Dowel Steel (9/64" x 1.5)
47. **PLATE**, Supt Lk
48. **SHROUD**, Hsg
49. **ACTUATOR**, Ign Sw
50. **PIN**, Inhibitor
51. **SPRING**, Cbl Bkdrv Pin
52. **PIN**, Cable Backdrive
53. **JACKET**, Col
54. **SCREW**, Ign Sw
55. **STUD**, Dimr & Ign Sw
56. **SWITCH**, Ign
57. **BRACKET**, Cable
58. **BEARING**, Adapter
59. **SCREW**, Hex Wa Hd Tap (M4.2 x 1.41 x 20)
60. **SEAT**, Lwr Brg
61. **SPRING**, Lwr Brg
62. **RETAINER**, Spring
63. **SEAL**, Dash
64. **NUT**, Hex (5/16"-18 x 1/4")
65. **WASHER**, Supt Lwr
66. **SUPPORT**, Lwr
67. **PLUG**, Jacket
68. **NUT**, Hex (#10-24)
69. **SWITCH**, Dimr
70. **ROD**, Dimr Sw
71. **SHAFT ASM**
72. **ROD**, Telescope Lk
73. **SHAFT**, Upr
74. **WEDGE**, Locking
75. **YOKE**, w/Race
76. **SPHERE**, Shf Ctr
77. **SPRING**, Joint Preload
78. **SHAFT**, Lwr
79. **BOLT**, Inter Shaft
80. **SHAFT**, Strg Gr
81. **SHIELD**, Strg Gr Cplg Lwr
82. **SHIELD**, Strg Gr Cplg Upr

"Y" STEERING COLUMN & INTERMEDIATE SHAFT

Fig. 3B5-1 Part List

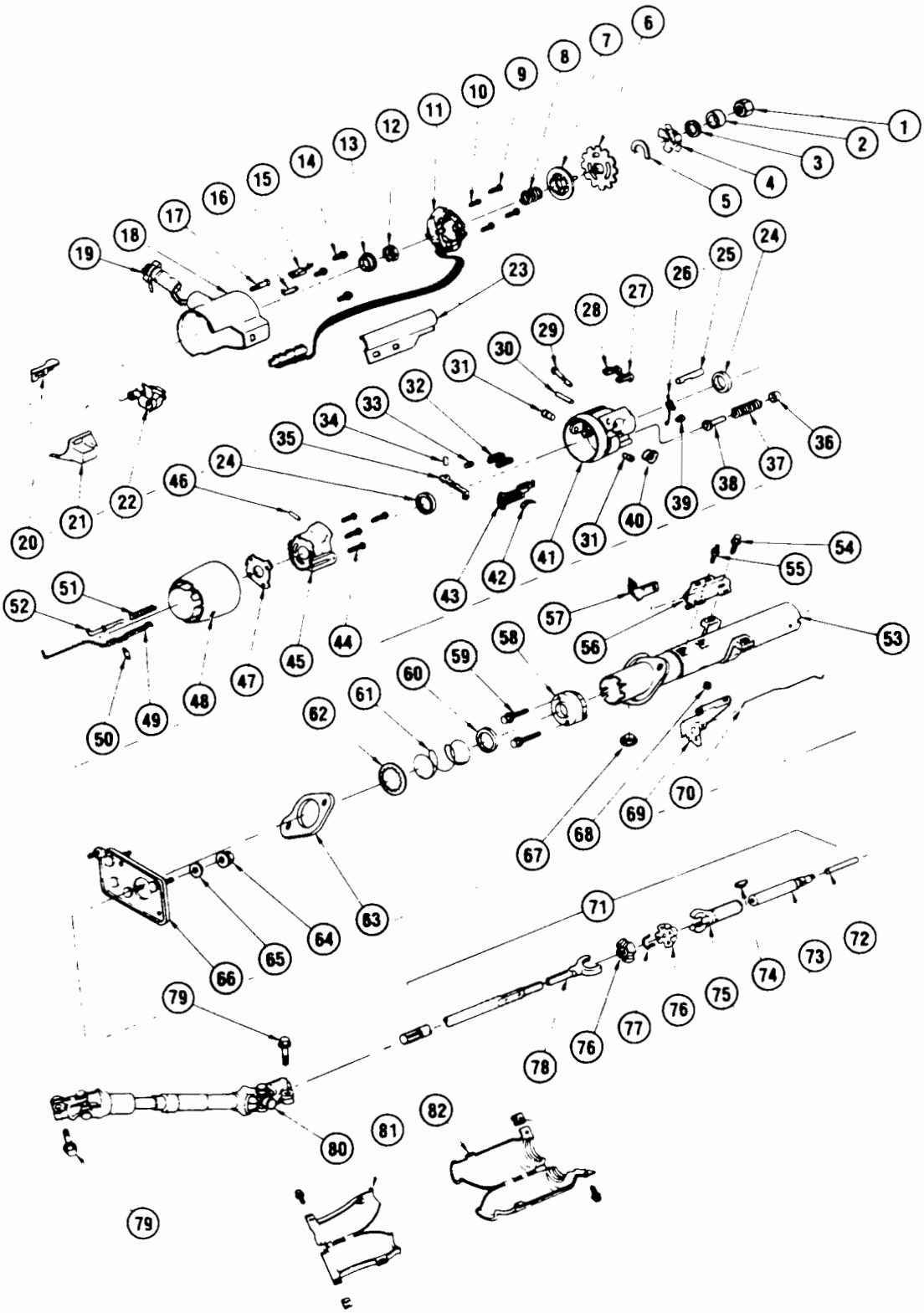


Fig. 3B5-2 Steering Column Explode

REMOVE AND INSTALL STEERING WHEEL

REMOVE

1. Squeeze horn cap (top and bottom) disengage locking fingers, and remove cap.
2. Carefully pull horn contact plate from steering wheel. Disconnect horn lead wire.
3. Remove telescope adj. lever asm. and wheel nut.
4. Using Tool J-1859-03, remove wheel asm.

INSTALL

1. Wheel in reverse order.
2. Telescope adj. lever asm.
3. Connect horn lead wire.
4. Align contact plate (with horn lead wire asm. on the bottom) and press-in.
5. Align the horn cap (top of cap up) with the openings in the contact plate.
6. Then using two (¼" square) spacers as shown, press the cap to seat the three locking fingers. Withdraw the spacers.

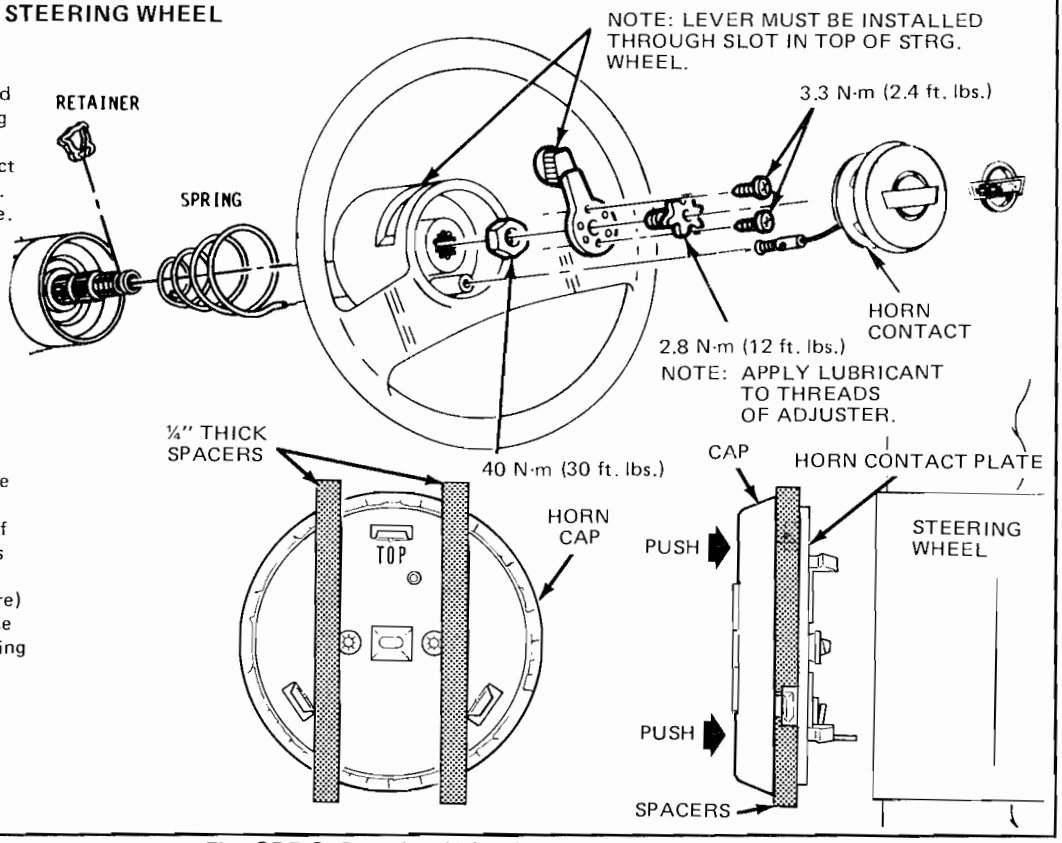


Fig. 3B5-3–Steering Wheel

REMOVE AND INSTALL INTERMEDIATE SHAFT

REMOVE

1. DISENGAGE UPPER SHIELD AND RETAINING HOOK. REMOVE SHIELD.
2. DISENGAGE LOWER SHIELD AND RETAINING HOOK. REMOVE SHIELD.
3. REMOVE BOLTS AS SHOWN.

INSTALL

1. ASSEMBLE INTERMEDIATE SHAFT TO STEERING RACK AND COLUMN. TORQUE TO SPECS.
2. INSTALL "U" NUT TO LOWER SHIELD. FOLD SHIELD AROUND JOINT, ENGAGING RETAINING HOOK, AND SECURE TO STEERING RACK. TORQUE TO SPECS.
3. INSTALL "U" NUT TO UPPER SHIELD. FOLD SHIELD AROUND JOINT, ENGAGING RETAINING HOOK, AND SECURE TO STEERING COLUMN. TORQUE TO SPECS.

GROOVE IN SHIELD-UPPER TO BE SEATED OVER STEERING COLUMN BEARING AFTER ASSEMBLY

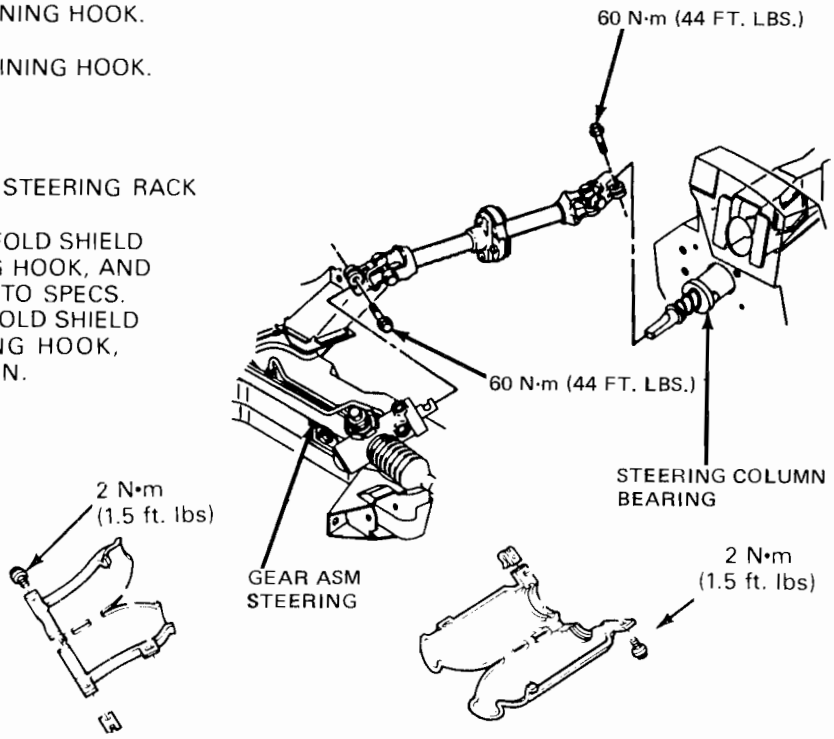


Fig. 3B5-4–Intermediate Shaft

REMOVE AND INSTALL STEERING COLUMN

NOTICE: Once the steering column is removed from the car, the column is extremely susceptible to damage. Dropping the column assembly on its end could collapse the steering shaft or loosen the plastic injections which maintain column rigidty. Leaning on the column assembly could cause the jacket to bend or deform. Any of the above damage could impair the column's collapsible design. If it is necessary to remove the steering wheel, use standard wheel puller. Under no condition should the end of the shaft be hammered upon as hammering could loosen the plastic injections which maintain column rigidity.

REMOVE

1. DISCONNECT BATTERY.
2. REMOVE PINCH BOLT AT UNIVERSAL COUPLING.
3. REMOVE LOWER STEERING COLUMN ATTACHING BOLT.
4. REMOVE 2 CAPSULE BOLTS.
5. DISCONNECT ALL ELECTRICAL CONNECTORS FROM STEERING COLUMN
6. REMOVE STEERING COLUMN ASSEMBLY.

INSTALL

1. POSITION STEERING COLUMN ASSEMBLY INTO VEHICLE AND INSERT COLUMN SHAFT INTO "U" JOINT OF INTERMEDIATE SHAFT. RETAIN WITH BOLT AND TORQUE TO SPEC.
2. LOOSELY ATTACH COLUMN TO SUPPORT STUDS ON DASH AND TOE PANEL WITH WASHERS AND NUTS TO I P REINFORCEMENT ASSY. NUTS.
3. TORQUE TO SPECS.
4. INSTALL PINCH BOLT AT FLEXIBLE COUPLING.
5. CONNECT ALL ELECTRICAL CONNECTORS TO STEERING COLUMN.
6. CONNECT BATTERY CABLE.

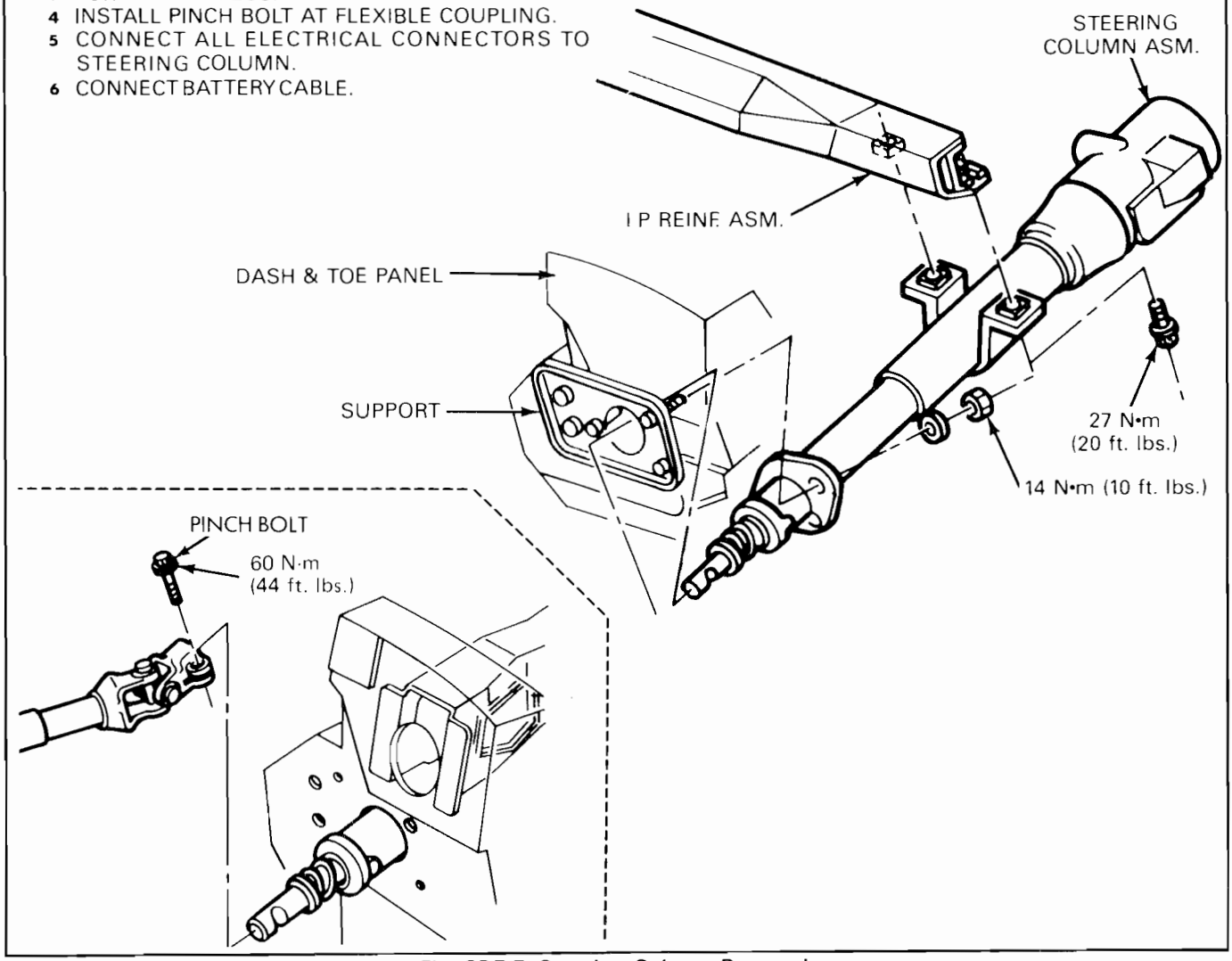
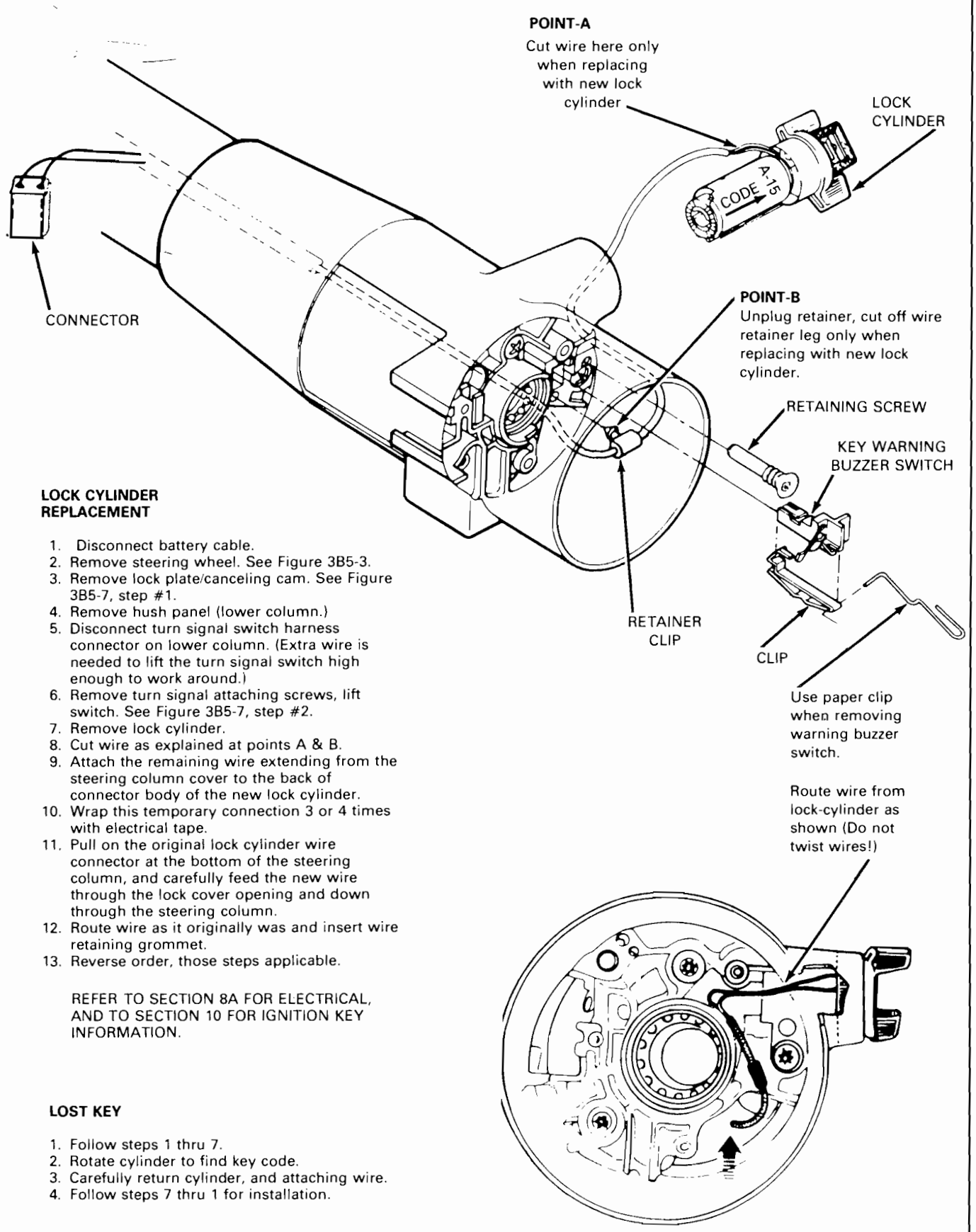


Fig. 3B5-5–Steering Column Removal



LOCK CYLINDER REPLACEMENT

1. Disconnect battery cable.
2. Remove steering wheel. See Figure 3B5-3.
3. Remove lock plate/canceling cam. See Figure 3B5-7, step #1.
4. Remove hush panel (lower column.)
5. Disconnect turn signal switch harness connector on lower column. (Extra wire is needed to lift the turn signal switch high enough to work around.)
6. Remove turn signal attaching screws, lift switch. See Figure 3B5-7, step #2.
7. Remove lock cylinder.
8. Cut wire as explained at points A & B.
9. Attach the remaining wire extending from the steering column cover to the back of connector body of the new lock cylinder.
10. Wrap this temporary connection 3 or 4 times with electrical tape.
11. Pull on the original lock cylinder wire connector at the bottom of the steering column, and carefully feed the new wire through the lock cover opening and down through the steering column.
12. Route wire as it originally was and insert wire retaining grommet.
13. Reverse order, those steps applicable.

REFER TO SECTION 8A FOR ELECTRICAL, AND TO SECTION 10 FOR IGNITION KEY INFORMATION.

LOST KEY

1. Follow steps 1 thru 7.
2. Rotate cylinder to find key code.
3. Carefully return cylinder, and attaching wire.
4. Follow steps 7 thru 1 for installation.

Figure 3B5-6 Lock Cylinder

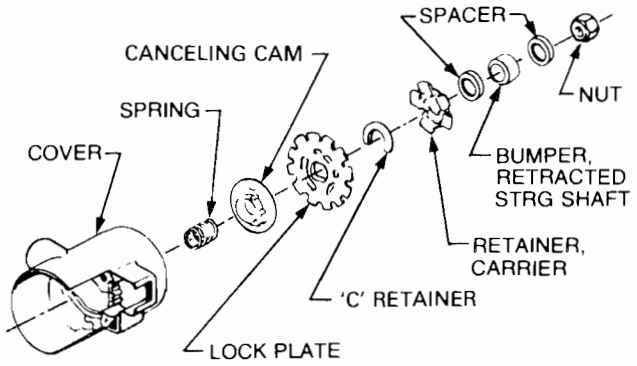
1. REMOVE AND INSTALL LOCK PLATE AND/OR CANCELLING CAM

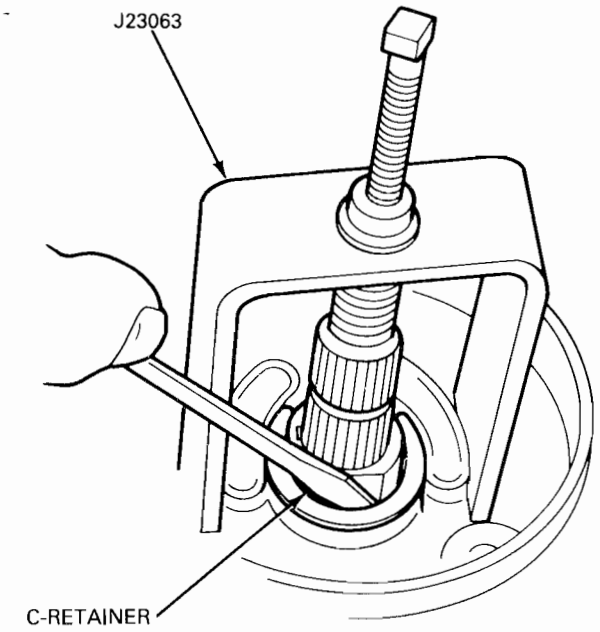
REMOVE

1. Disconnect negative battery cable.
2. Remove steering wheel. See Figure 3B5-3.
3. Remove parts as shown.

INSTALL

1. Install parts as shown.
2. Install steering wheel. See Figure 3B5-3.
3. Connect negative battery cable.





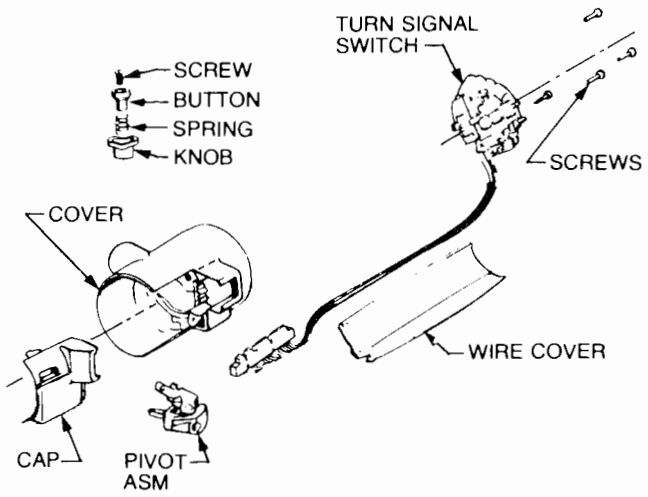
2. REMOVE AND INSTALL TURN SIGNAL SWITCH

REMOVE

1. Remove parts as shown.

INSTALL

1. Install parts as shown.



3. REMOVE AND INSTALL IGNITION LOCK AND KEY WARNING BUZZER

REMOVE

1. Turn lock to "RUN" position and remove key warning buzzer.
2. Remove parts as shown.

INSTALL

1. Install lock cylinder.
2. Turn lock to "RUN" position and install key warning buzzer switch.

To assemble, rotate to stop while holding cylinder.

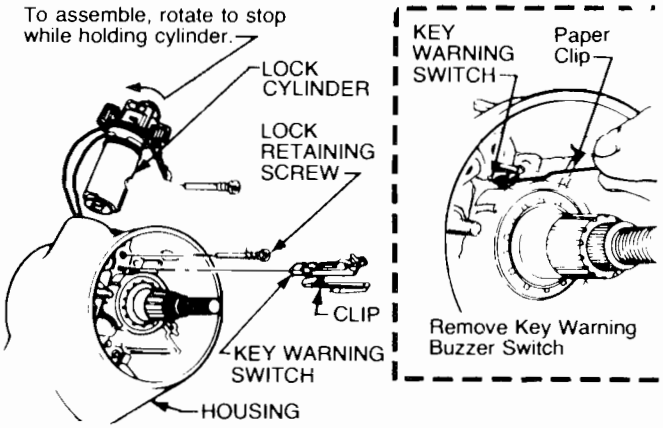


Fig. 3B5-7–Repair-A

4. REMOVE AND INSTALL HOUSING

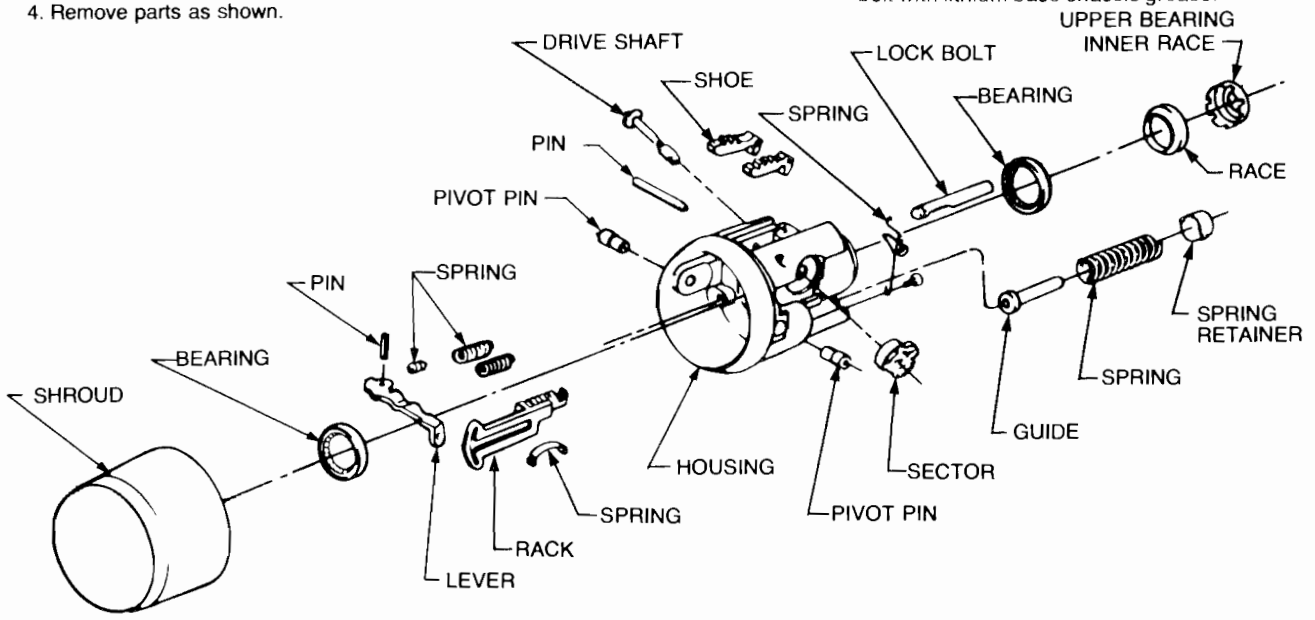
REMOVE

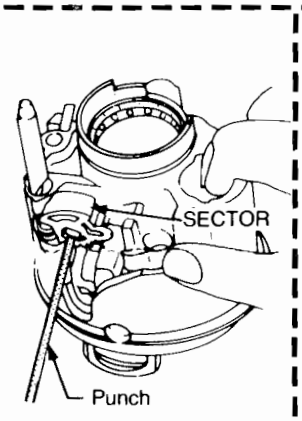
1. Reinstall tilt lever and place column in full "UP" position. Remove tilt lever.
2. Remove tilt spring and pivot pins.
3. Remove housing by pulling upward to extend rack full down and moving housing to the left to disengage rack from actuator.
4. Remove parts as shown.

INSTALL

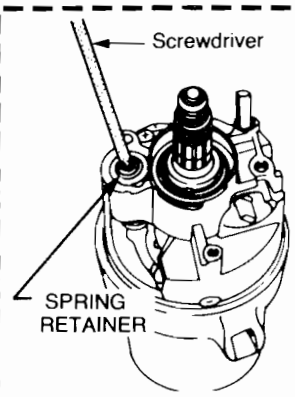
1. Install parts as shown.
2. While holding up on tilt lever to disengage lock shoes install over steering shaft. Move rack downward and hold. Tip housing to the left until rack engages pin on actuator rod. Push housing down until pivot pin holes are in alignment.

Note: Liberally coat exposed area of lock bolt with lithium base chassis grease.

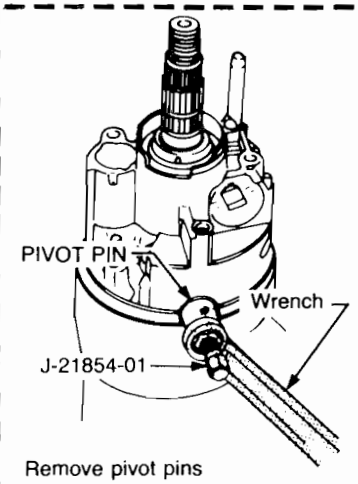




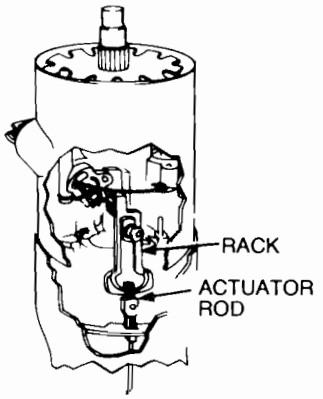
Remove drive shaft and sector



Remove tilt spring retainer



Remove pivot pins



Engage rack

5. REMOVE AND INSTALL STEERING SHAFT

REMOVE

1. Remove parts as shown.

INSTALL

1. Install parts as shown.

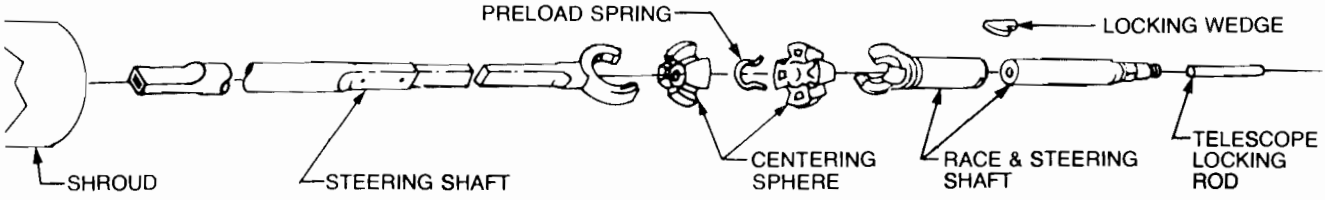


Fig. 3B5-8–Steering Column Repair-B

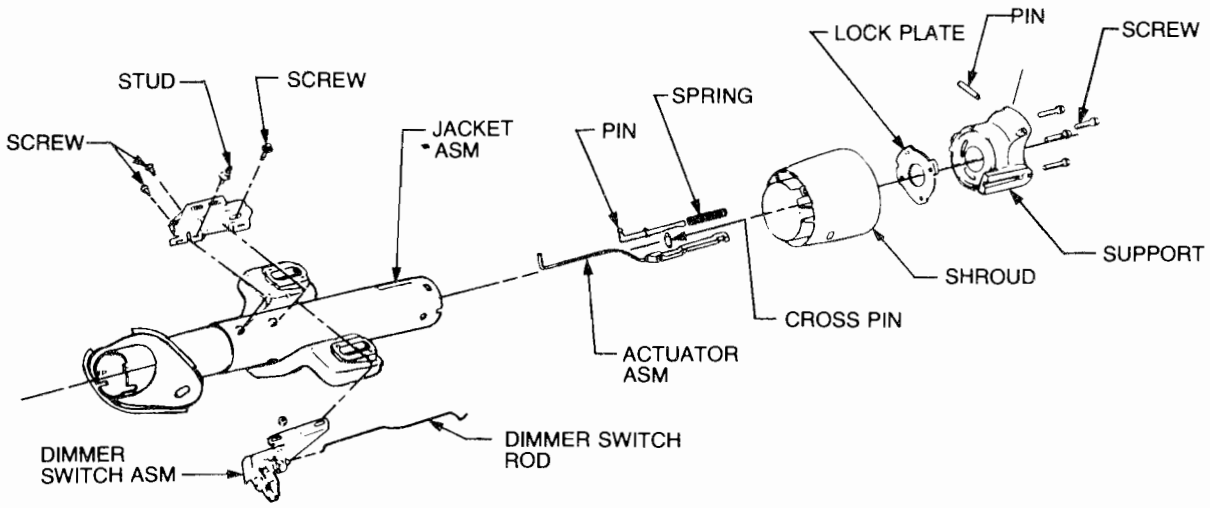
6. REMOVE AND INSTALL IGNITION AND DIMMER SWITCH

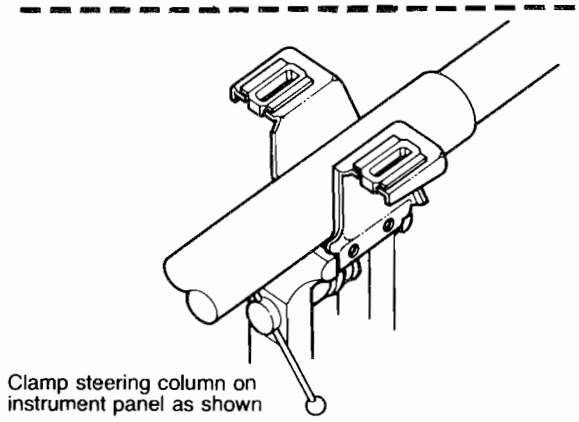
REMOVE

1. Remove parts as shown.

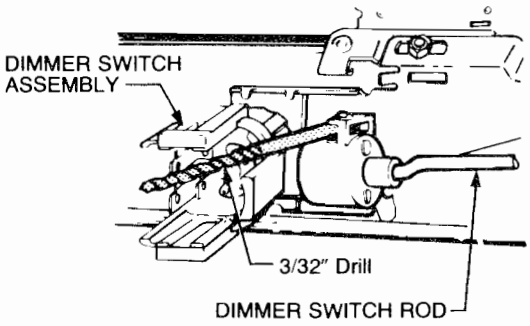
INSTALL

1. Install parts as shown.
2. Position rod in slider hole and install ignition switch. Install lower stud and tighten to 4.0 N·m (35 In. Lbs.).
3. Install dimmer switch and depress switch slightly to insert 3/32" drill. Force switch up to remove lash, then tighten screw and nut to 4.0 N·m (35 In. Lbs.).





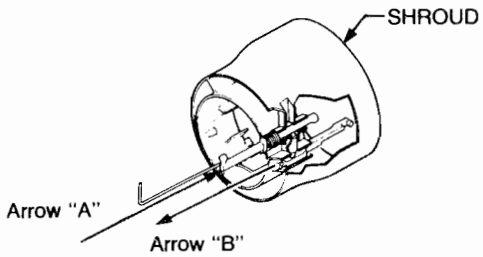
Clamp steering column on instrument panel as shown



Adjust dimmer switch assembly

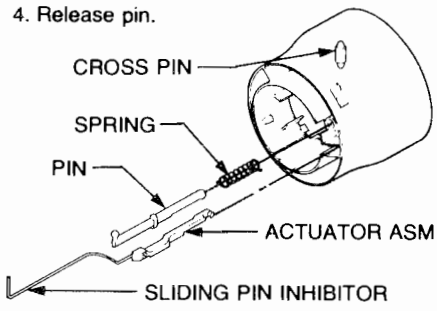
REMOVE

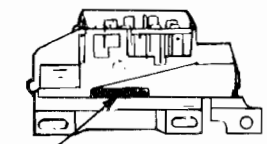
1. Push pin as far as possible into shroud in direction of arrow "A".
2. Remove actuator asm in direction of arrow "B".
3. Remove cross pin through opening in shroud.



INSTALL

1. Push spring and pin into shroud as far as possible.
2. Insert cross pin as far as possible into shroud slot.
3. Insert actuator asm as shown.
4. Release pin.





Move slide to extreme right position (ACC). Then move slider two detents to the left to "OFF UNLOCK" position.

Install ignition switch assembly

Fig. 3B5-9–Steering Column Repair-C

CHECKING STEERING COLUMN FOR ACCIDENT DAMAGE

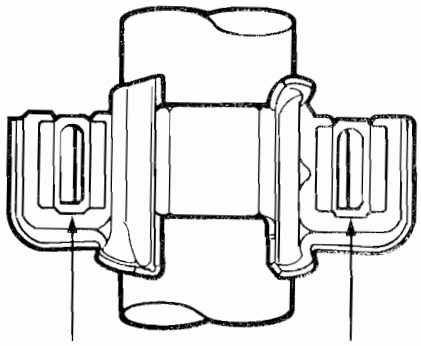
NOTICE: Cars involved in accidents resulting in frame damage, major body or sheet metal damage, or where the steering column has been impacted may also have a damaged or misaligned steering column.

CHECKING PROCEDURE

1. Check capsules on steering column bracket assembly; all should be within 1.59mm (1/16") from the bottom of the slots. (View A) If not bracket should be replaced.

2. Check contact surface "A". (View B) The bolthead must not contact surface "A" or shear load would be increased. If contact is made, replace bracket.

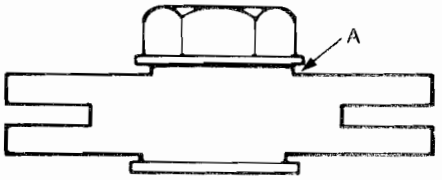
3. Check for jacket collapse by measuring as shown in view C. If jacket dimensions are not within specifications a new jacket must be installed. Visually inspect for sheared injected plastic in the steering shaft view E. If sheared replace with a new steering shaft.



Capsules must be within 1.59mm (1/16") from bottom of slots. If not, replace jacket assembly.

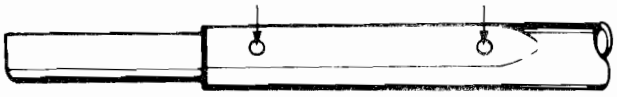
View A

The bolt head must not contact surface "A". If contact is made, the capsule shear load will be increased–Replace bracket.

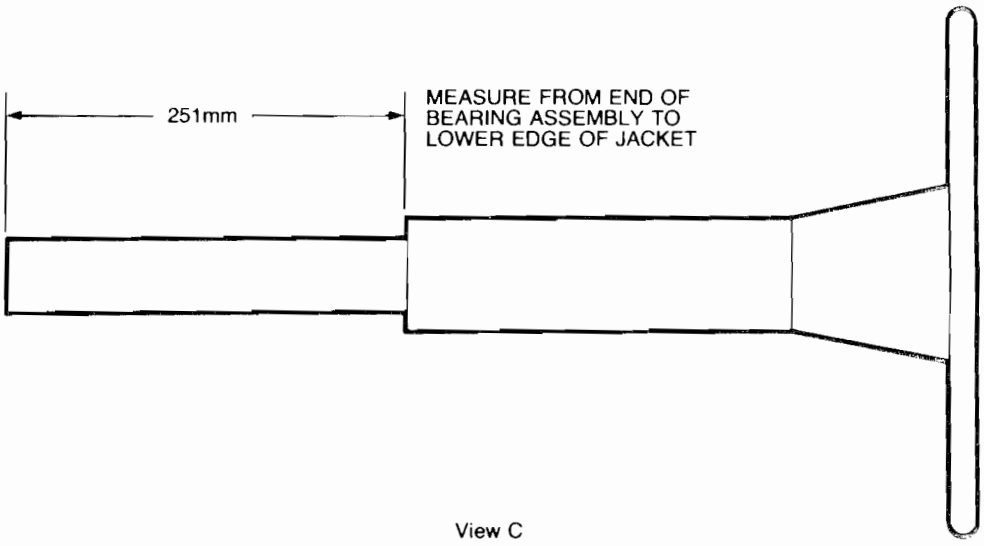


View B

Check for sheared injected plastic at these locations.



View E



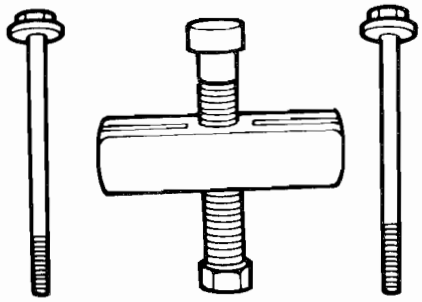
View C

Fig. 3B5-10–Accident Damage Check

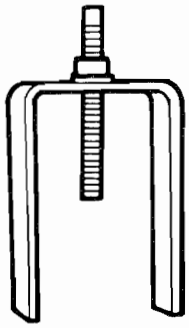
TORQUE SPECIFICATIONS

APPLICATION	N·m	FT.LBS.	IN.LBS.
Steering Wheel to Shaft Nut	40	30	
Turn Signal Switch Attaching Screws	4		35
Steering Column Telescope Adj. Screws	2.8		24
Steering Column Telescope Lever Screws	3.3		40
Support to Lock Plate Screws	14	10	
Steering Column Bracket to Frame	27	20	
Steering Column to Intermediate Shaft	60	44	
Intermediate Shaft to Steering Gear	60	44	

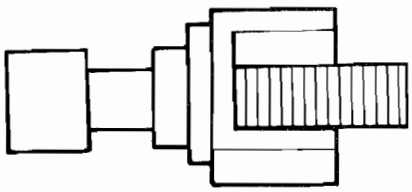
SPECIAL TOOLS



J1859-03
STEERING WHEEL PULLER



J23063
LOCK PLATE DEPRESSER



J21854-01
PIVOT PIN REMOVER

Fig. 3B5-11–Specifications/Tools

SECTION 3B9

POWER RACK AND PINION

NOTICE: The wheel bolt and nut fasteners are an important attaching part in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

CONTENTS

General Description 3B9-1
Remove and Install Rack & Pinion 3B9-2
Remove and Install Power Steering Belt 3B9-3
Steering System Bleeding Instructions 3B9-3
Remove and Install Power Steering Hoses 3B9-4
Remove and Install Power Steering Pump 3B9-5
Power Rack and Pinion Explode 3B9-9
Power Rack and Pinion Overhaul 3B9-10
Specifications and Special Tools 3B9-13

DESCRIPTON OF POWER STEERING RACK AND PINION

The power rack and pinion steering system has a rotary control valve which directs hydraulic fluid, coming from the hydraulic pump, to either side of the rack piston. The integral rack piston is attached to the rack and converts hydraulic pressure to a linear force which moves the rack left or right. The force is then transmitted through the inner and outer tie rods to the steering knuckles which turn the wheels.

If hydraulic assist is not available, manual control is maintained. However, under these conditions, an increase in effort can be expected. The motion of turning the steering wheel is transferred to the pinion. The motion of the pinion is then transferred through the pinion teeth which mesh with teeth on the rack, which moves the rack.

A vane type, constant displacement pump - with remote oil reservoir provides hydraulic pressure for the system.

DESCRIPTION OF POWER STEERING PUMP

The major components of the power steering pump are the drive shaft, pump housing, pump ring, pressure plate, thrust plate, flow control valve, rotor and vanes.

There is an opening at the rear of the pump housing. This opening contains the pump ring, pressure plate, thrust plate, rotor, vanes and end plate. A small opening on the side of the housing contains the pressure line fitting, flow control valve, and spring. The flow control orifice is part of the pressure line fitting. A pressure relief valve inside the flow control valve limits pump pressure.

Component Replacement Recommendations

Lip seals, which seal rotating shaft, require special treatment. This type of seal is used on the steering rack and pinion at the rack, at the pinion and valve, and on the drive shaft of the pump. When leakage occurs in one of these areas, always replace the seal(s), after inspecting and thoroughly cleaning the sealing surfaces. Replace the shaft only if very severe pitting is found except for the rack. If the rack shows evidence of corrosion, it should be replaced. If the corrosion in the lip seal contact zone is slight, clean the surface of the shaft with crocus cloth. Replace the shaft only if the leakage cannot be stopped by smoothing with crocus cloth first.

REMOVAL AND INSTALLATION OF POWER RACK AND PINION ASSEMBLY

REMOVAL

1. Slide a drain pan below.
2. Disconnect the inlet and outlet hose and pipe from gear valve.
3. Loosen the front lug nuts.
4. Raise the vehicle.
5. Remove both front wheels.
6. Disconnect both tie rod ends using tool J-24319-01. See section 3C.
7. Remove stabilizer bar assembly, includes both holding brackets. See section 3C.
8. Remove the return pipe (mounted on the gear). Includes the two brackets.
9. Disconnect the left cylinder feed pipe at the cylinder.
10. Remove the rack mounting through bolt.
11. Remove the front saddle mounting nut and bolt.
12. Lower the vehicle.
13. Remove the rear saddle mounting nut and bolt.
14. Remove the steering shaft pinch bolt at gear.
15. Raise or lower the vehicle to aid in removal of the rack and pinion assembly.

INSTALLATION

1. Reverse order for installation.
2. Torque nut and bolts shown below.
3. Bleed the system.
4. Check and adjust toe.

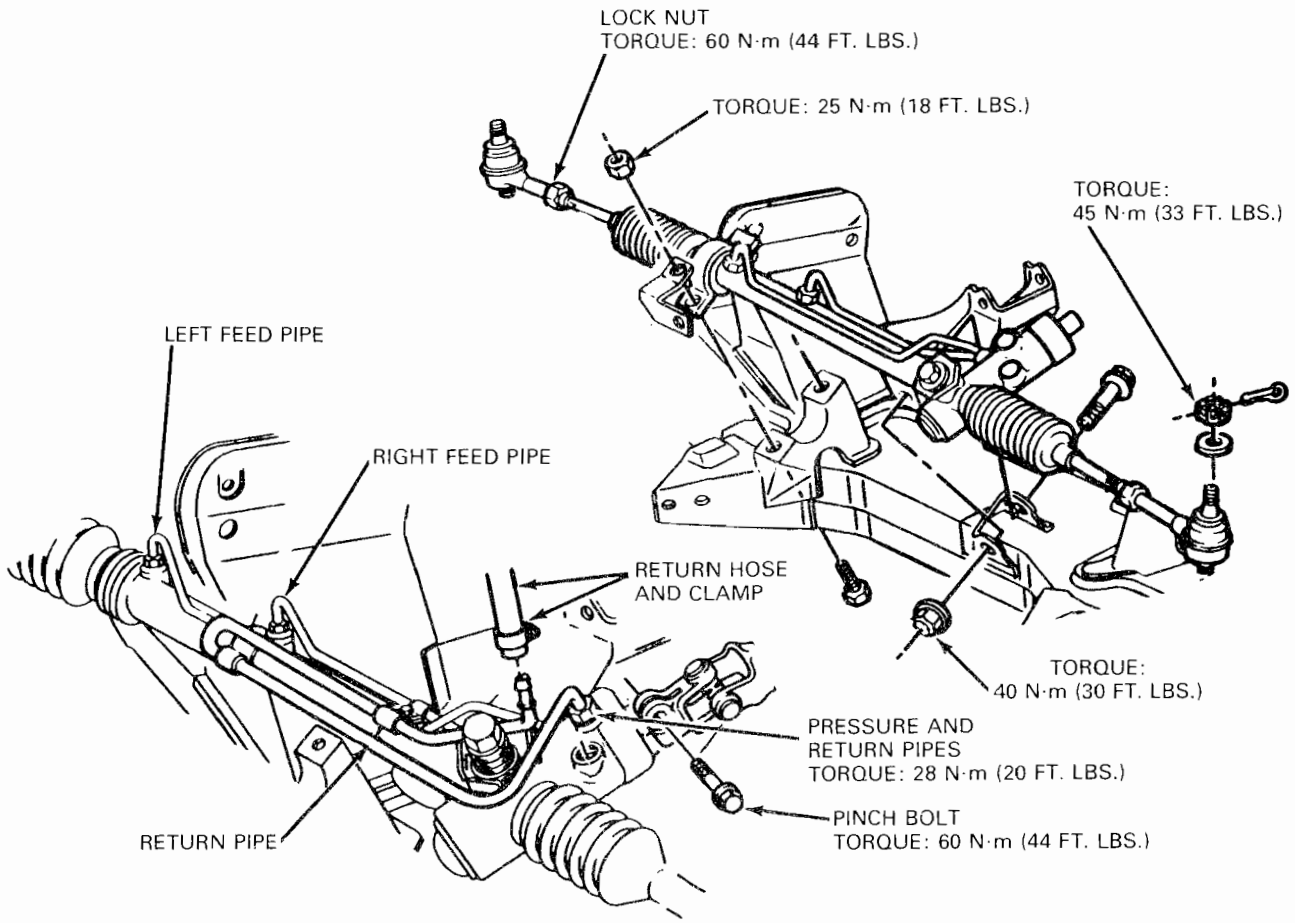


Fig. 3B9-1--Power Rack and Pinion Assy

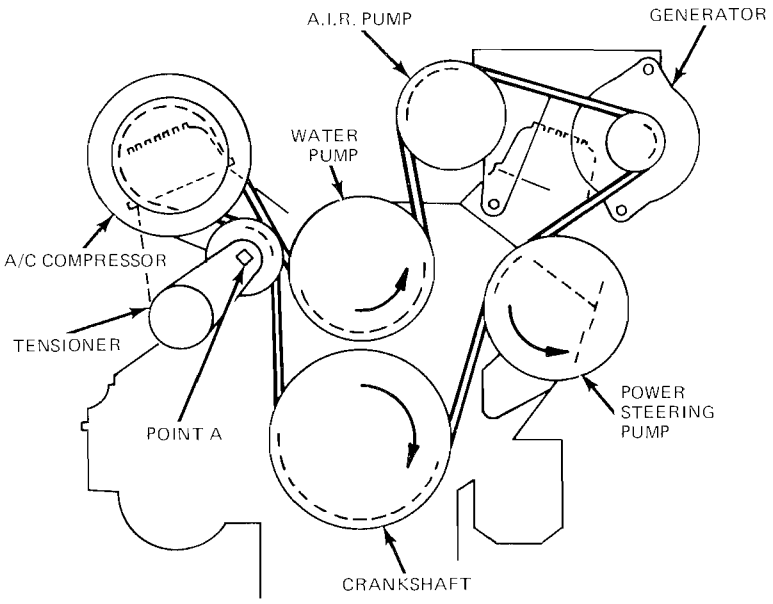
SINGLE BELT ACCESSORY DRIVE

A single (serpentine) belt is used to drive all engine accessories formerly driven by multiple drive belts. All belt driven accessories are ridgedly mounted with belt tension maintained by a spring loaded tensioner.

Routine inspection of the belt may reveal cracks in the belt ribs. These cracks will not impair belt performance and therefore should not be considered a problem requiring belt replacement. However, the belt should be replaced if belt slip occurs or if sections of the belt ribs are missing.

To remove or install the belt, lift (rotate) the tensioner using a 1/2 inch breaker bar at point A.

To check belt tension, install belt tension gage BT-7825 or J-23600 between the alternator and A.I.R. pump. Belt tension should be 534-623 N·m (120-140 lbs.)



1985 BELT ROUTING

Fig. 3B9-2--R&I Power Steering Belt

HYDRAULIC STEERING SYSTEM BLEEDING INSTRUCTIONS

System Bleed

1. Fill reservoir with fluid.
2. Run engine 5 to 10 seconds with wheels in straight ahead position.
3. Fill reservoir (engine stopped).
4. Run engine for a few seconds and turn wheels in both directions against stops.
5. Stop engine, fill reservoir.

A noisy pump is usually caused by air mixed in with the fluid. Low fluid causes foaming but will bleed out after 2 to 3 hours of standing, fill reservoir with fluid.

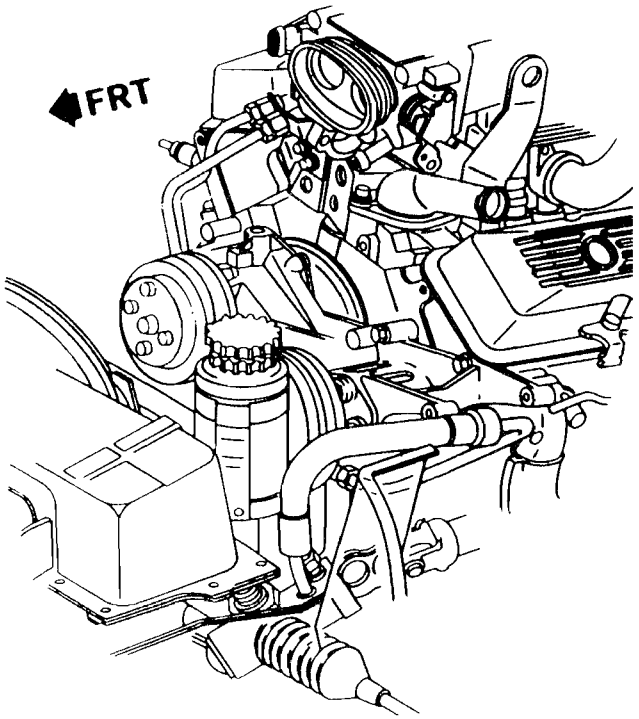


Fig. 3B9-3--Power Steering System Bleeding

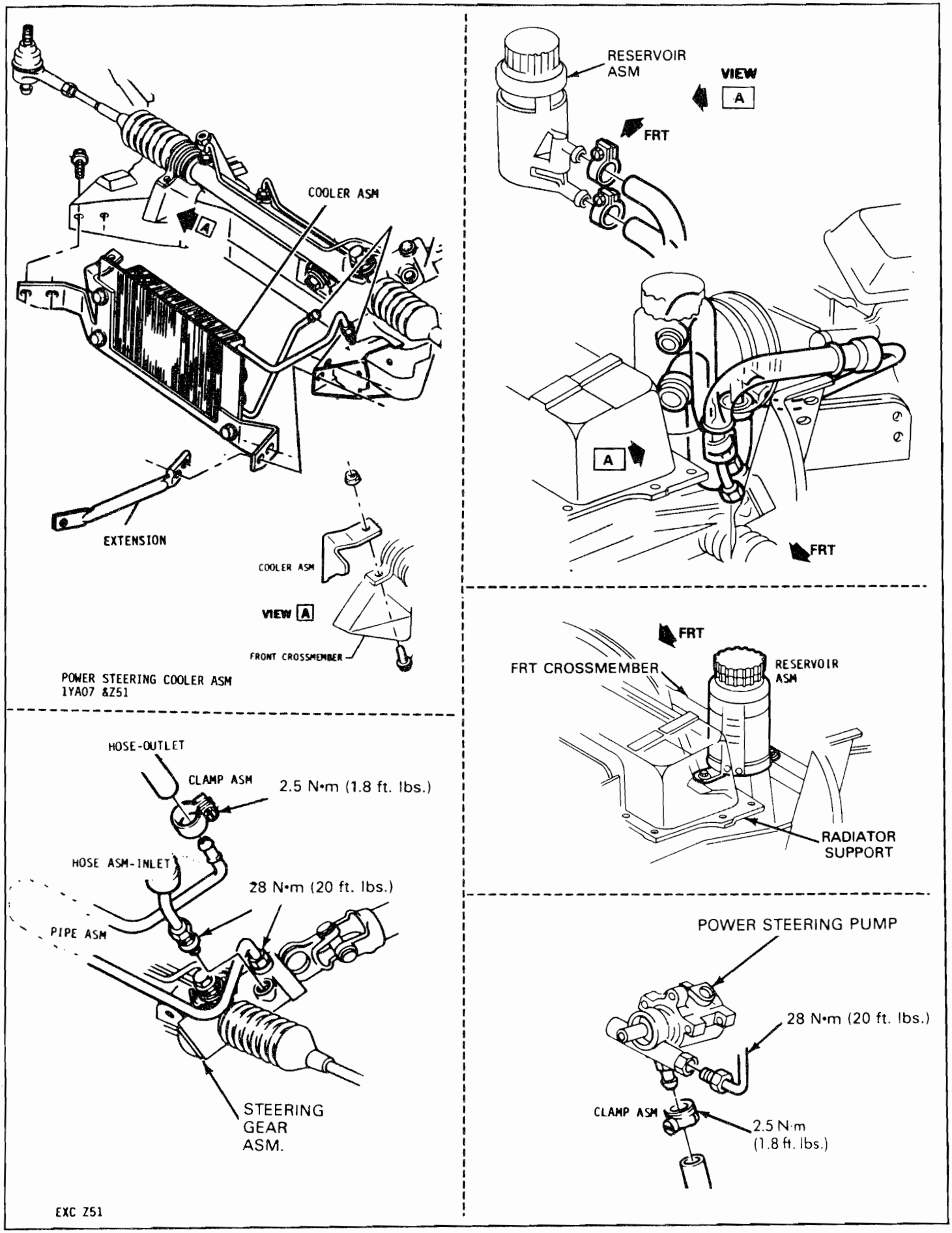


Fig. 3B9-4--R&I Power Steering Hoses

REMOVE AND INSTALL POWER STEERING PUMP, BRACKET

REMOVE

1. REMOVE SERPENTINE BELT.
2. REMOVE P/S PUMP PULLEY.
3. REMOVE PARTS AS SHOWN.

INSTALL

1. INSTALL PARTS AS SHOWN.
2. INSTALL AIR PUMP PULLEY.
3. INSTALL SERPENTINE BELT AND TIGHTEN TENSIONER.

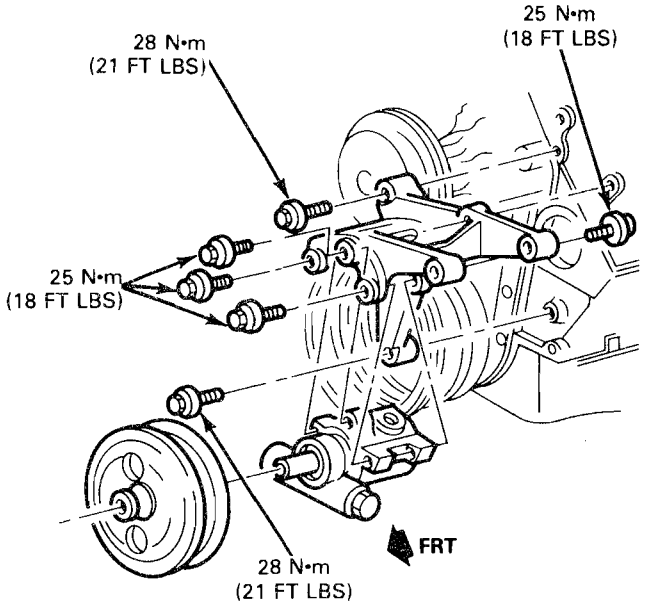


Fig. 3B9-5--R&I Power Steering Pump

1-HOUSING ASM., HYD. PUMP
2-SLEEVE, ASM.
3-PIN, DOWEL
4-SEAL, O-RING
5-SPRING, PRESSURE PLATE
6-SEAL, O-RING
7-PLATE, PRESSURE
8-PIN, PUMP RING DOWEL (2)
9-VANE (10)
10-ROTOR, PUMP
11-RING, PUMP
12-SEAL, O-RING
13-PLATE ASM., THRUST
14-RING, THRUST PLATE RETAINING
15-TUBE, RETURN
16-SEAL, DRIVE SHAFT
17-SHAFT, DRIVE
18-BEARING ASM., BALL
19-RING, RETAINING
20-SPRING, FLOW CONTROL
21-VALVE ASM., CONTROL
22-SEAL, O-RING
23-FITTING, O-RING UNION

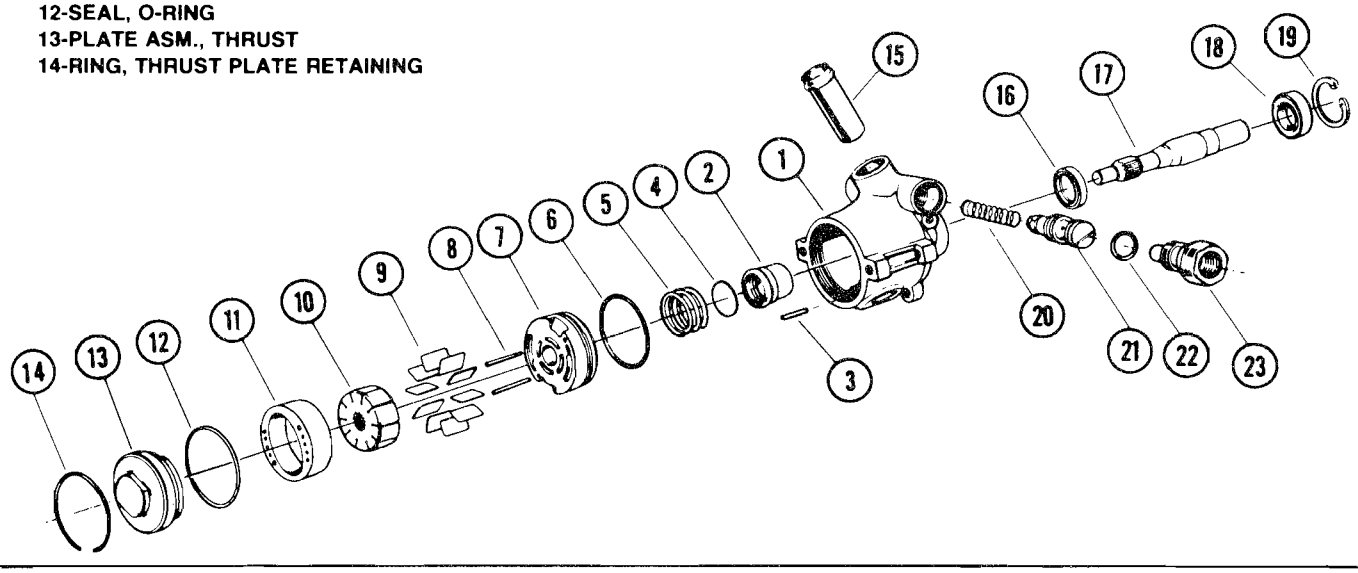


Fig. 3B9-6--TC Pump Explode

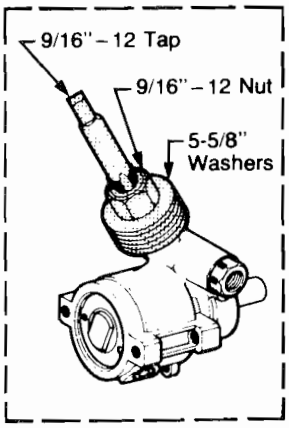
1. REMOVE AND INSTALL RETURN TUBE

REMOVE

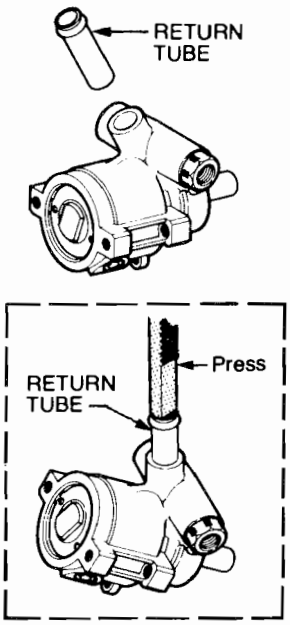
1. Plug return tube to prevent chips from entering pump.
2. Use tap, washers and nut to remove damaged return tube.

INSTALL

1. Using Loctite Solvent 75559 and Loctite 290 Adhesive, or equivalent, coat end of the new return tube.
2. Using a press, press tube into housing until bottomed.



Remove return tube



Install return tube

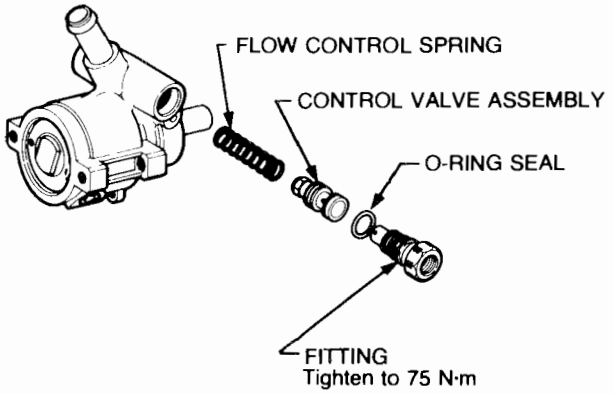
2. REMOVE AND INSTALL CONTROL VALVE ASSEMBLY

REMOVE

1. Remove parts as shown.

INSTALL

1. Install parts as shown.
2. Tighten to specifications.



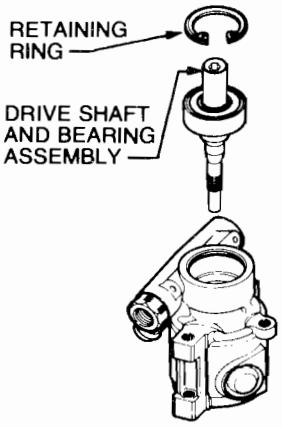
3. REMOVE AND INSTALL DRIVE SHAFT AND OR BALL BEARING ASSEMBLY

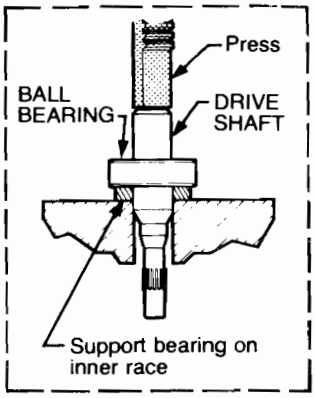
REMOVE

1. Remove retaining ring with suitable snap ring pliers.
2. Remove drive shaft and bearing assembly from housing.
3. Refer to inset for bearing removal.

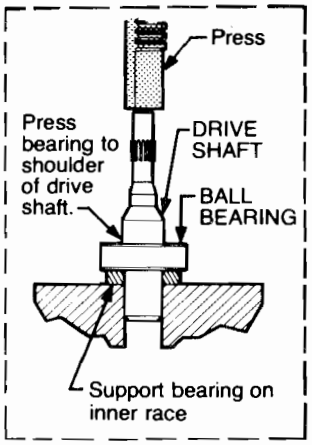
INSTALL

1. See inset for installation of bearing on drive shaft.
2. Slide assembly into housing while rotating drive shaft so shaft serrations engage with rotor.
3. Bottom bearing in housing.
4. Install retaining ring with beveled side outward.

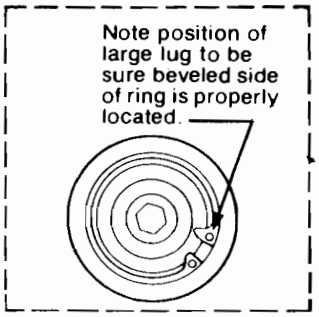




Remove bearing



Install bearing



Install retaining ring

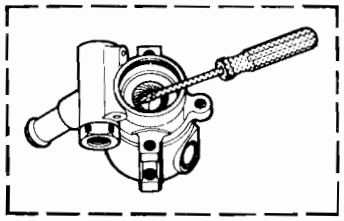
4. REMOVE AND INSTALL DRIVE SHAFT SEAL

REMOVE

1. Using a screwdriver, pry seal from housing.

INSTALL

1. Using suitable socket, press seal into housing until bottomed.



Seal removal

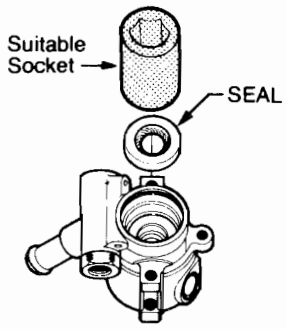
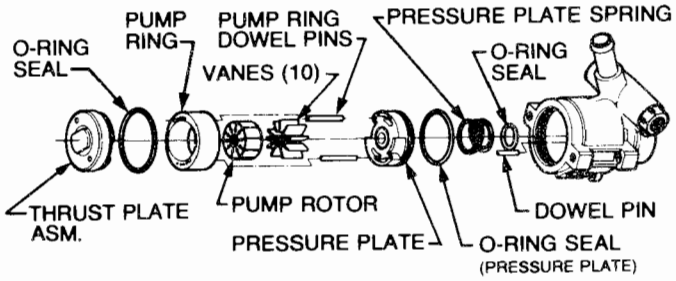


Fig. 3B9-7--TC Pump OH-A

5. REMOVE AND INSTALL ROTATING GROUP

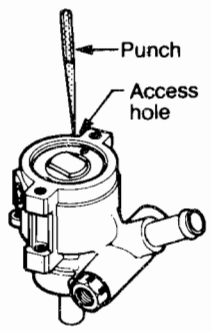
REMOVE

1. Using a small punch in the access hole, remove the retaining ring.
2. Using a 5/8" piece of bar stock or suitable brass drift, press on pressure plate hub from drive shaft side of housing until thrust plate can be removed.
3. The O-ring seal in housing must be removed next. It is now possible to remove the remaining parts of the rotating group from housing. It may still be necessary to use a press to remove the pressure plate.
4. Remove O-ring seal from the sleeve assembly and dispose.

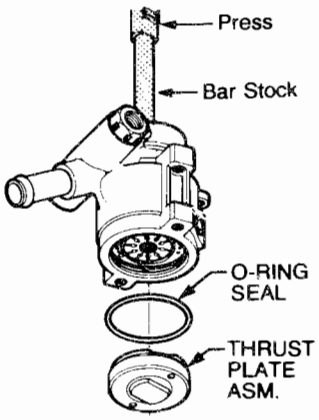


INSTALL

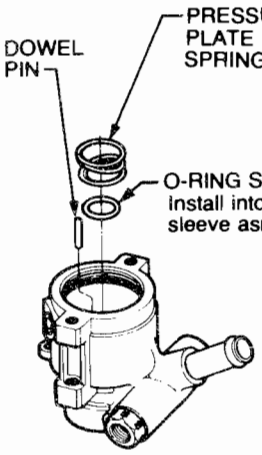
1. Lubricate new O-ring seal and install into sleeve assembly.
2. Insert dowel pin in housing.
3. Install spring over sleeve assembly in housing.
4. Lubricate O-ring seal and install on pressure plate.
5. Mark top of pressure plate directly over dowel pin hole in plate. This will help line up hole with dowel pin.
6. Install pressure plate in housing. Be sure dowel pin and hole in pressure plate engage properly.
7. Install two (2) pump ring dowel pins in holes in pressure plate. Slide pump ring over these two pins. Be sure identification marks on pump ring are facing downward with rear of pump facing upward.
8. Install rotor with counter bore side toward drive shaft end of housing. Add ten vanes.
9. Lubricate O-ring seal and install in housing.
10. Install thrust plate in housing, making sure that dimples in thrust plate line up with bolt holes in housing and that thrust plate engages pump ring dowel pins.
11. Using a press, press on thrust plate far enough to install retaining ring.
12. Install retaining ring with opening of ring centered with bolt hole in housing nearest to access hole.



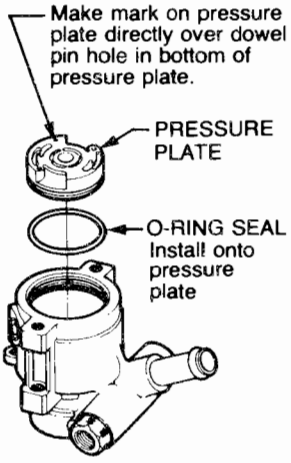
Retaining ring removal



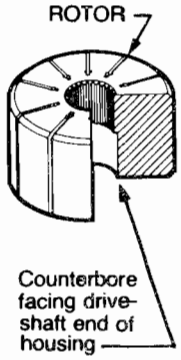
Thrust plate removal



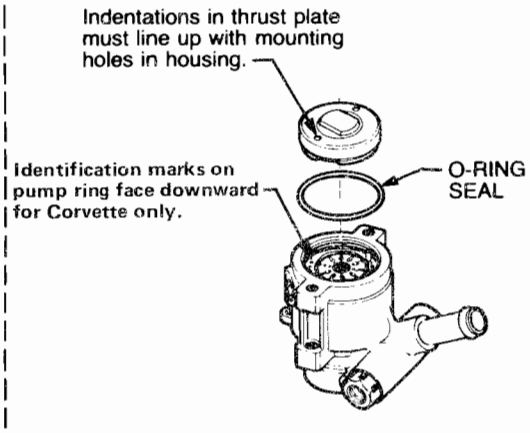
Install spring



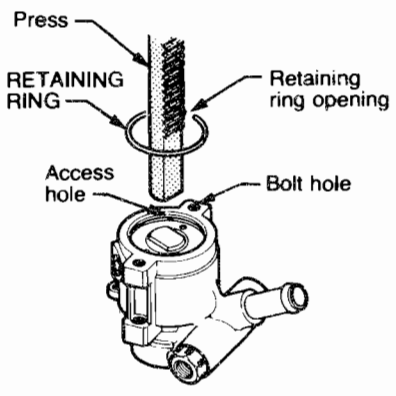
Install pressure plate



Install rotor



Install seal and thrust plate.



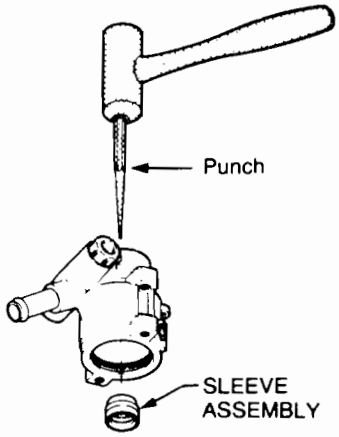
Install retaining ring

Fig. 3B9-8--TC Pump OH-B

6. REMOVE AND INSTALL SLEEVE ASSEMBLY

REMOVE

1. From the drive shaft side of housing, remove sleeve assembly using a punch.



INSTALL

1. Using a suitable socket, press sleeve assembly into housing from pressure plate side.
2. Be sure sleeve assembly is fully seated in housing.

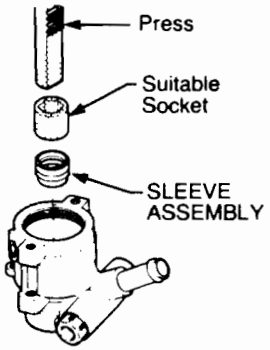
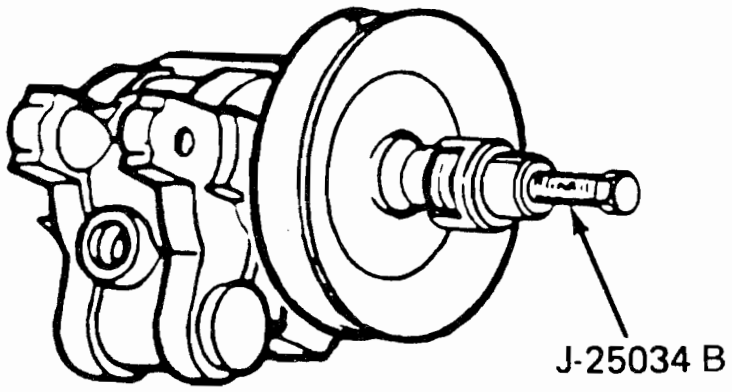


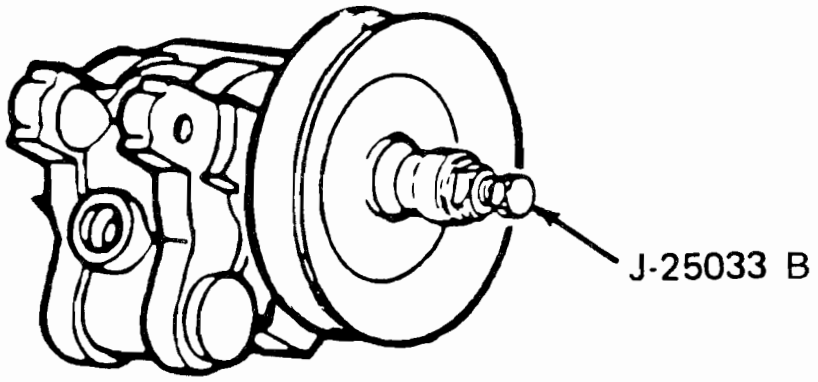
Fig. 3B9-9-TC Pump OH-C

PULLEY REMOVAL

REMOVE POWER STEERING PUMP PULLEY



INSTALL POWER STEERING PUMP PULLEY



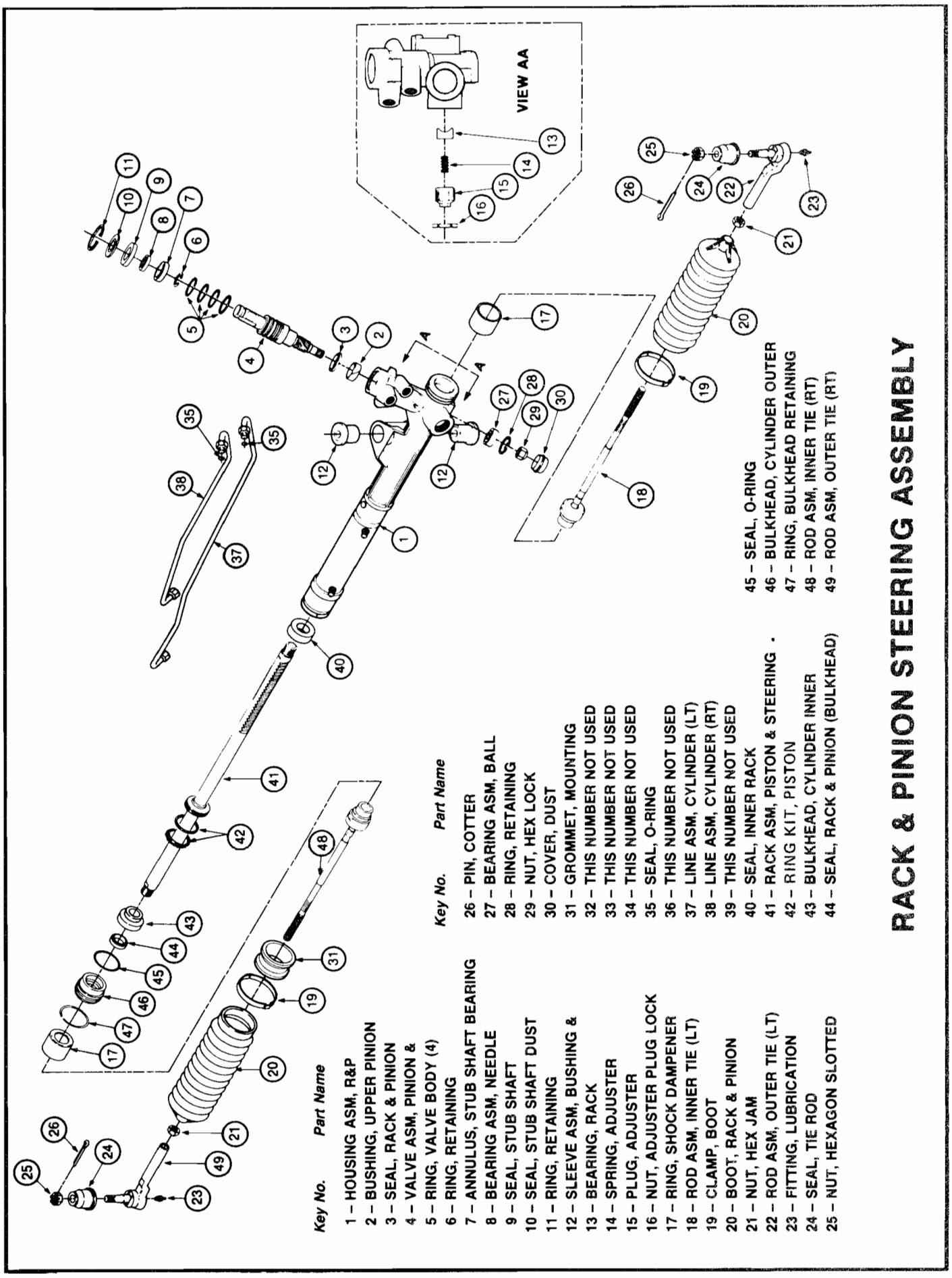


Fig. 3B9-10--Rack and Pinion OH-A

1. REMOVE AND INSTALL OUTER TIE ROD

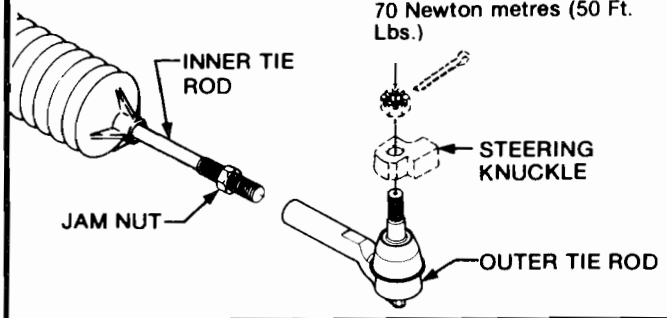
REMOVE

1. Loosen jam nut.
2. Remove tie rod from steering knuckle, using Tool J-24319-01 or BT 7101.
3. Remove outer tie rod.

INSTALL

1. Install parts as shown.
2. Do not tighten jam nut.
3. Make toe-in adjustment by turning inner tie rod.
4. Be sure boot is not twisted.

NOTICE: Torque jam nut to 70 Newton metres (50 Ft. Lbs.)



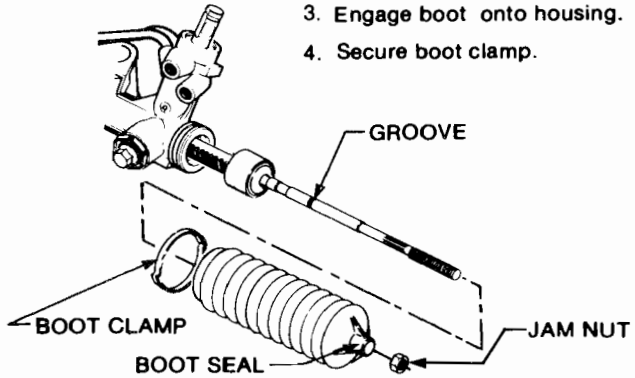
2. REMOVE AND INSTALL BOOT SEAL

REMOVE

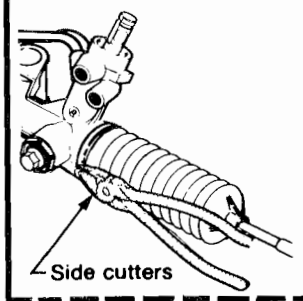
1. Remove jam nut.
2. Cut boot clamp and discard.
3. See insert for proper boot seal removal.

INSTALL

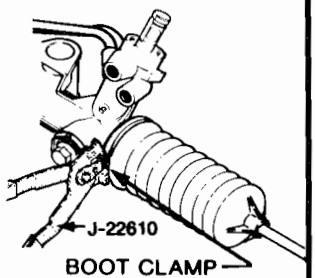
1. Install new clamp on boot before installing boot.
2. See insert for proper installation of boot seal.
3. Engage boot onto housing.
4. Secure boot clamp.



A. Cut boot clamp

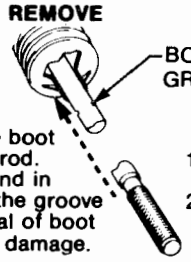


B. Secure boot clamp



REMOVE

To prevent boot damage, slide tie rod end of boot toward center of gear enough to expose boot groove on the tie rod. Place a rubber band in groove. This fills the groove and allows removal of boot from gear without damage.



REPLACE



1. Remove rubber band.
2. Slide boot on tie rod until boot snaps into groove.

THE FOLLOWING STEPS MUST BE PERFORMED WITH RACK & PINION ASSEMBLY REMOVED FROM CAR

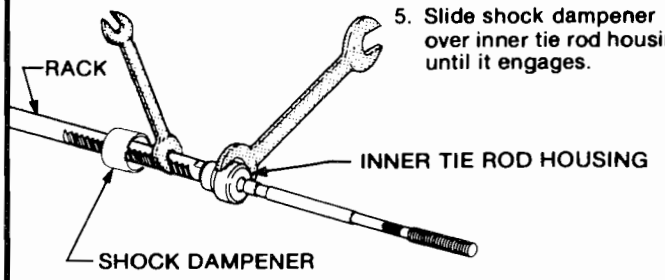
3. REMOVE AND INSTALL INNER TIE ROD

REMOVE

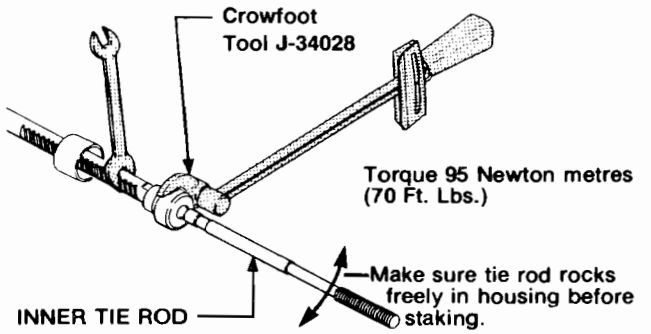
1. Remove shock dampener ring from inner tie rod housing and slide back on rack.
2. Put wrench on rack flat to prevent rack damage when removing tie rod.
3. Put wrench on tie rod pivot housing flats.
4. Turn housing counter-clockwise until tie rod assy separates from rack.

INSTALL

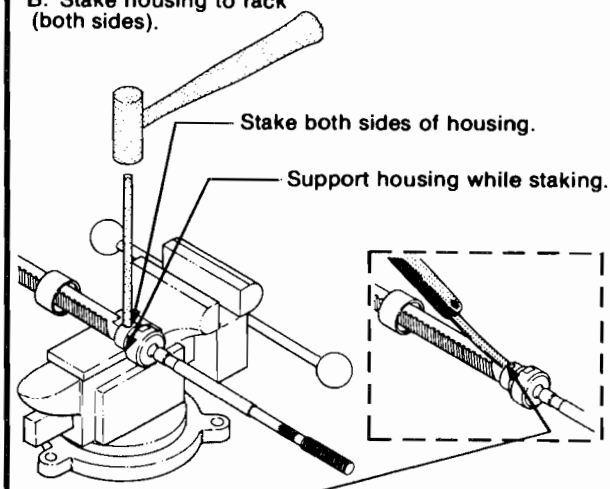
1. Bottom inner tie rod assy on rack.
2. Torque housing. (Use wrench on rack to avoid internal gear damage.)
3. Support rack and housing and stake tie rod housing to rack flat. (Stake both sides.)
4. Inspect stake, a .25 millimetres (.010 inch) feeler gage must not pass between rack and housing stake on both sides.
5. Slide shock dampener over inner tie rod housing until it engages.



A. Torque inner tie rod.



B. Stake housing to rack (both sides).



.25 Millimetres (.010 inch) feeler gage must not pass between rack and housing stake. (Check both sides.)

Fig. 3B9-11--Rack and Pinion OH-B

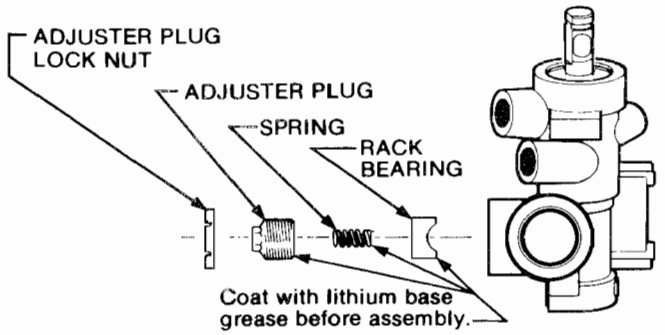
4. REMOVE AND INSTALL RACK BEARING

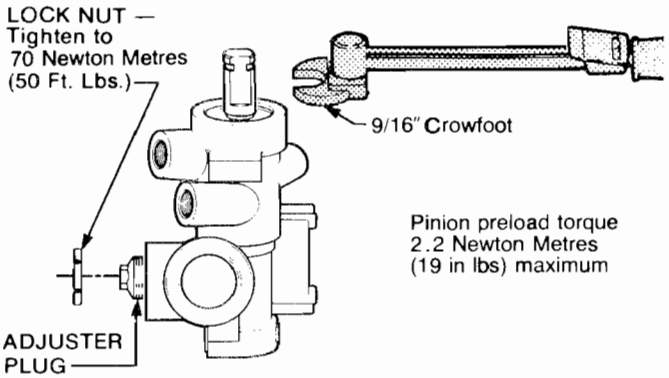
REMOVE

1. Loosen adjuster plug lock nut.
2. Turn adjuster plug counterclockwise until it separates from housing.
3. Remove parts as shown.

INSTALL

1. Install parts as shown.
2. Turn adjuster plug clockwise until it bottoms, then back off 50° to 70°. Check torque on pinion.
3. Assemble lock nut and tighten while holding adjuster plug stationary.





5. REMOVE AND INSTALL STUB SHAFT SEALS

REMOVE

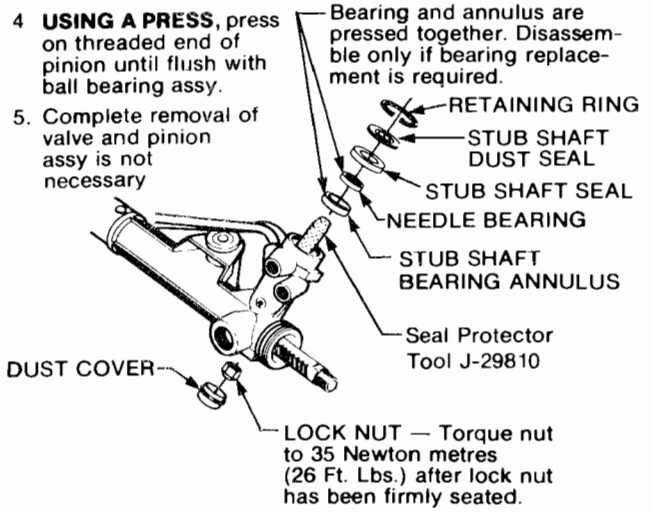
1. Remove retaining ring.
2. Remove dust cover.
3. While holding the stub shaft remove lock nut from pinion.

   NOTICE: If stub shaft is not held, damage to the pinion teeth will occur.

4. **USING A PRESS,** press on threaded end of pinion until flush with ball bearing assy.
5. Complete removal of valve and pinion assy is not necessary

INSTALL

1. Install annulus assembly in gear.
2. Place seal protector Tool J-29810 on stub shaft and install stub shaft seals and snapring.
3. While holding stub shaft firmly seat the lock nut, torque to specifications.



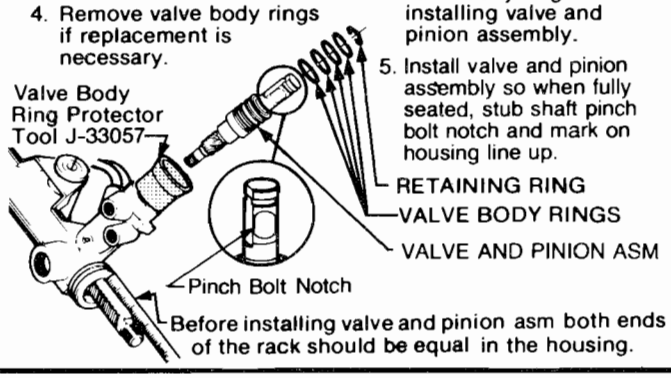
6. REMOVE AND INSTALL VALVE AND PINION ASM

REMOVE

1. Turn stub shaft until rack is equal distance on both sides of housing, with pinion fully engaged.
2. Mark location of stub shaft pinch bolt notch on housing.
3. **USING A PRESS,** press on threaded end of pinion until it is possible to remove valve and pinion assy.
4. Remove valve body rings if replacement is necessary.

INSTALL

1. Install new valve body rings if required.
2. Care should be taken not to cut rings at installation.
3. Measure rack so that it's equal on both sides.
4. Use valve body ring protector, Tool J-33057 to prevent damaging valve body rings while installing valve and pinion assembly.
5. Install valve and pinion assembly so when fully seated, stub shaft pinch bolt notch and mark on housing line up.



7. REMOVE AND INSTALL BULKHEAD

REMOVE

1. Use punch in access hole to remove bulkhead retaining ring.
2. If only the bulkhead, bulkhead O-ring seal or rack seal (bulkhead) are to be replaced. Loosen (LT) fitting and remove cylinder line.
3. Plug (LT) cylinder line hole at cylinder using a finger or plastic cap with 7/16 x 20 internal threads over hole to prevent oil leaking from cylinder.
4. Using a 9/16 crowfoot turn stub shaft. Move rack to the right forcing the bulkhead out of the housing. Use drain pan to catch hydraulic oil from assy.
5. If inner rack seal or piston ring are to be replaced, use rack to remove bulkhead instead of compressed oil method.

INSTALL

1. Using crocus cloth remove burrs or sharp edges from retaining ring groove in housing. This must be done to insure that the new O-ring is not damaged at assembly.
2. Install parts as shown.
3. Coat all seals with power steering fluid.
4. Slip bullet seal protector over end of rack and install bulkhead.
5. Make sure open end of retaining ring is approximately 13 millimeters (.50 inch) from access hole.
6. Retaining ring must be fully seated.

(Install Seal Using Seal Installer J-28527)

Rack Seal (Bulkhead) Removal

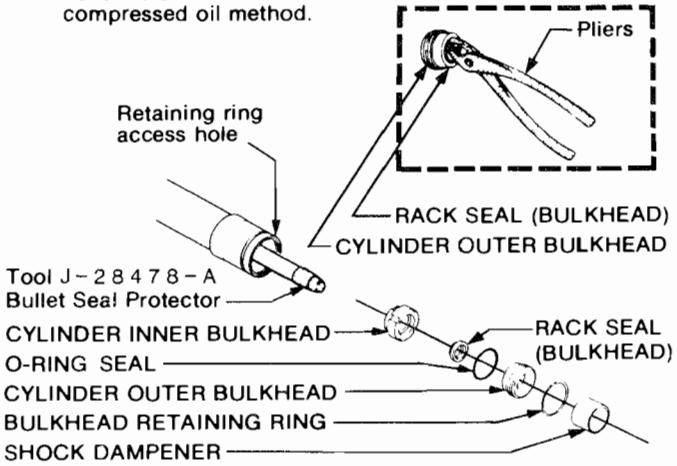


Fig. 3B9-12--Rack and Pinion OH-C

8. REMOVE AND INSTALL INNER RACK SEAL, RACK AND PISTON RING

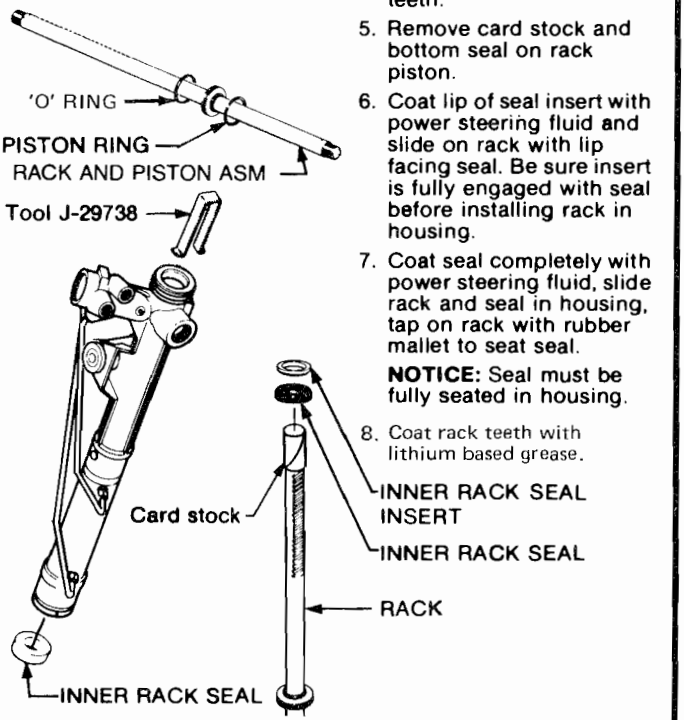
REMOVE

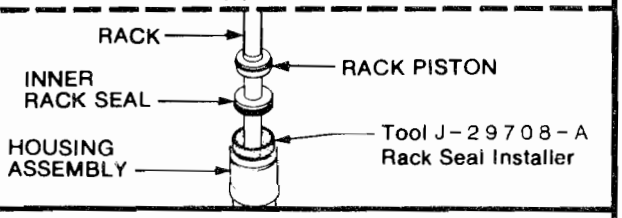
1. Remove rack from housing.
2. Remove both piston rings and dispose.
3. Fit tool J-29738 into housing. Using rod approx. 12" long, gently tap on rod until seal is removed.
4. Dispose of old seal.

INSTALL

1. Install new piston rings on rack.
2. Care should be taken not to cut ring at installation.
3. Wrap card stock around end of rack and rack teeth.
4. Coat seal lip with power steering fluid, slide seal with seal lip facing piston on to card stock, slide card and seal over rack teeth.
5. Remove card stock and bottom seal on rack piston.
6. Coat lip of seal insert with power steering fluid and slide on rack with lip facing seal. Be sure insert is fully engaged with seal before installing rack in housing.
7. Coat seal completely with power steering fluid, slide rack and seal in housing, tap on rack with rubber mallet to seat seal.

   NOTICE: Seal must be fully seated in housing.
8. Coat rack teeth with lithium based grease.





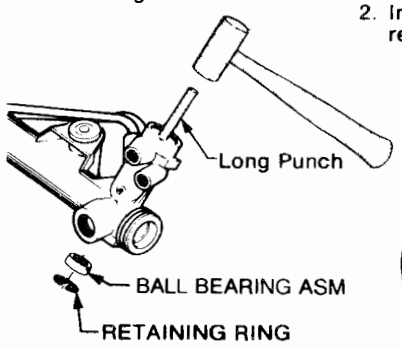
9. REMOVE AND INSTALL BALL BEARING ASM

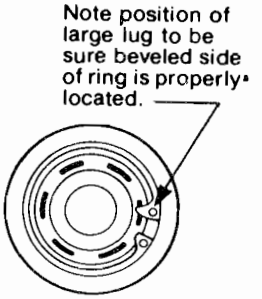
REMOVE

1. Remove bearing retaining ring.
2. Use drift or punch and gently tap on bearing until bearing is removed.

INSTALL

1. Install new ball bearing assy. Using a suitable socket, press on outer race. Be careful not to cock bearing in housing.
2. Install retaining ring. See reference below.





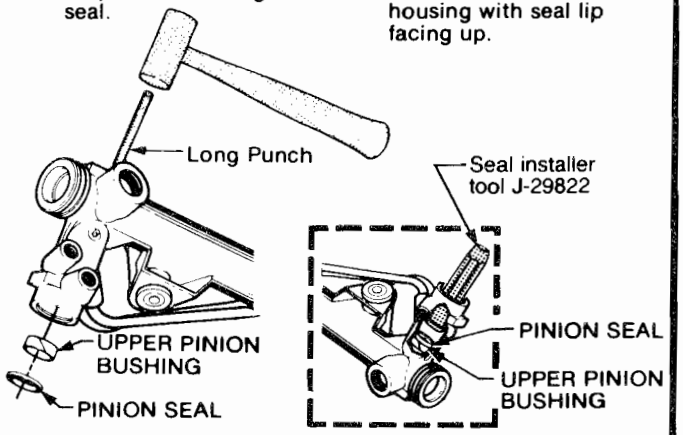
10. REMOVE AND INSTALL UPPER PINION BEARING & SEAL

REMOVE

1. Remove upper pinion bushing and seal with a punch.
2. Dispose of bushing and seal.

INSTALL

1. Install new bushing as shown.
2. Install new seal. Using installer, seat seal in housing with seal lip facing up.



11. REMOVE AND INSTALL CYLINDER LINE

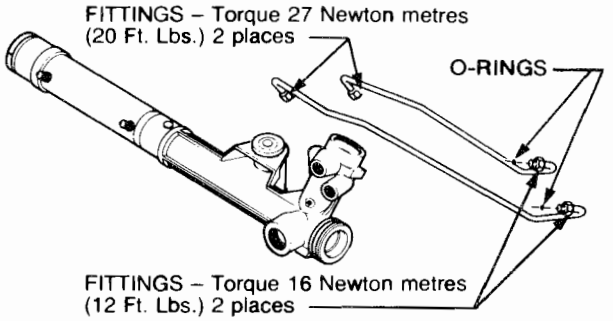
REMOVE

1. Using flare wrench loosen fittings and remove cylinder line.
2. Be sure O-ring is also removed and disposed of.

INSTALL

1. Place new O-ring seal on cylinder line.
2. Assemble both ends to housing finger tight to assure proper alignment.
3. Tighten to specifications.

   NOTICE: Care should be taken not to strip aluminum housing.



12. REMOVE AND INSTALL GROMMET OR BUSHING ASM

REMOVE

1. Slide mounting grommet from cylinder end of housing.
2. If the bushing and sleeve assemblies require replacement a press will be required to remove them from the housing.

INSTALL

1. Install mounting grommet onto cylinder end of housing.
2. Press new bushing & sleeve assemblies into housing.

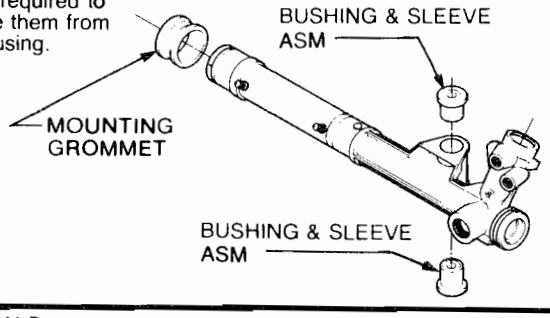


Fig. 3B9-13--Rack and Pinion OH-D

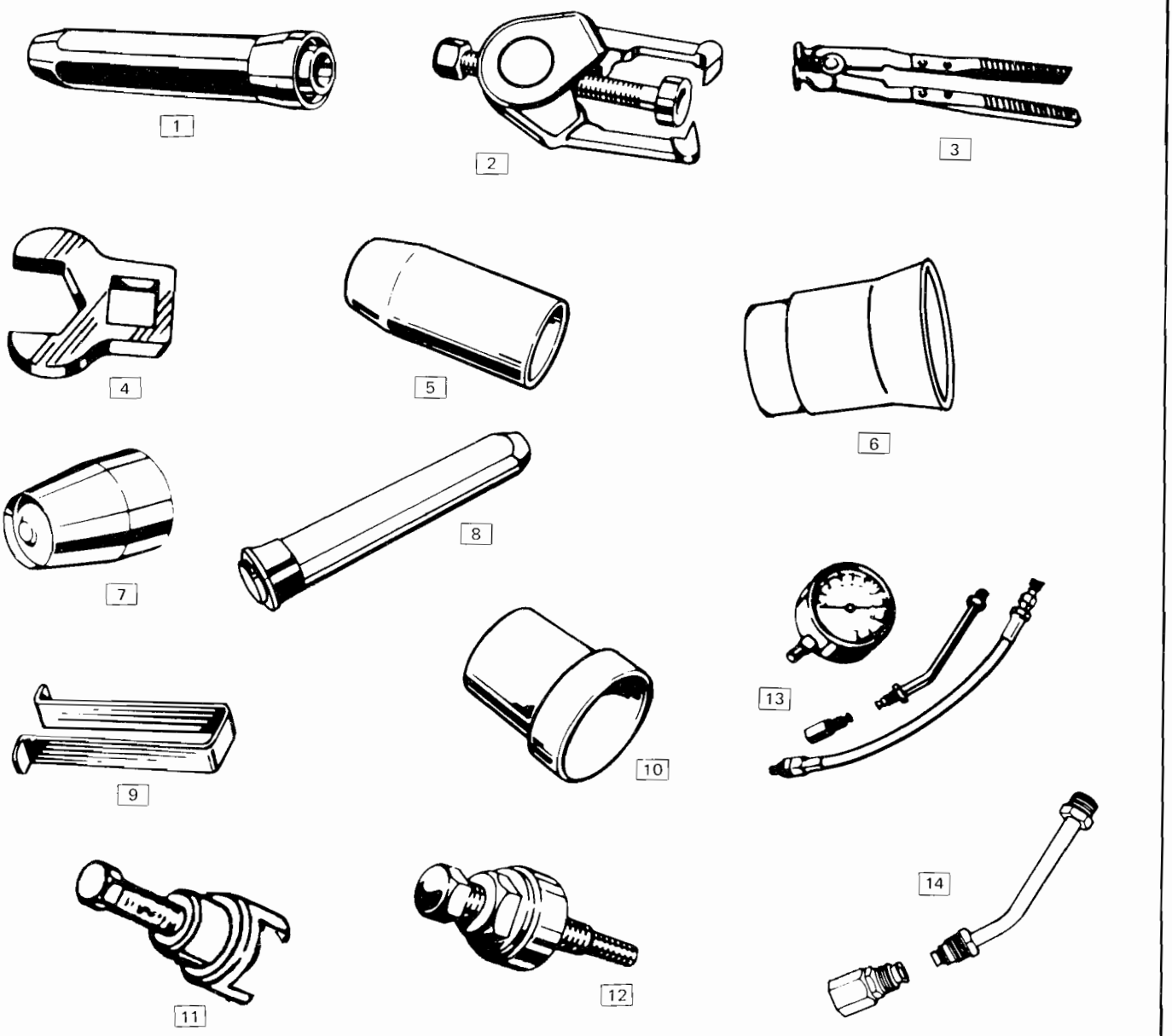
TORQUE SPECIFICATIONS

	N·m	Ft. Lbs.	In. Lbs.
Tie Rod Jam Nut	70	50	
Inner Tie Rod to Rack	95	70	
Lock Nut, Adjuster Plug	70	50	
Pinion Preload	2.2	—	19
Lock Nut, Pinion	35	26	
Fittings, Cylinder End	27	20	
Fittings, Valve End	16	12	
Steering Gear Clamp, Right Hand	25	18	
Steering Gear to Crossmember	34	25	
Steering Tie Rod to Knuckle	45	33	
Steering Gear Intermediate Shaft to Column	47	35	
Steering Gear Intermediate Shaft to Gear	62	46	
Steering Gear Intermediate Shaft Shields	2	—	18
Power Steering Reservoir to Generator Bracket	10	7	
Tie Rod Adjusting (@ Alignment)	63	46	
Power Steering Supply Hose Clamps	3	2	
Power Steering Hose to Pump	27	20	
Power Steering Pump Bracket to Engine Block & Head	34	25	
Power Steering Pump to Bracket	47	35	

NOTICE: Some people still believe you can use Automatic Transmission Fluid in Power Steering systems. **It just is not true.** Automatic Transmission Fluid **is not** compatible with the seals and hoses used in the power steering system. Using DEXRON II in the system can cause fluid seepage past the seals. Use only power steering fluid #1050017 or equivalent.



Fig. 3B9-14--Specs and Spec Tools



	TOOL DESCRIPTION	TOOL #
1:	BULKHEAD, RACK SEAL INSTALLER	J-28527
2:	TIE ROD REMOVER	J-24319-01
3:	RUBBER BOOT CLAMP PLIERS	J-22610
4:	CROWFOOT	J-34028
5:	SEAL PROTECTOR	J-29810
6:	VALVE BODY RING PROTECTOR	J-33057
7:	SEAL PROTECTOR	J-28478
8:	PINION SEAL INSTALLER	J-29822
9:	SEAL REMOVER	J-29738-A
10:	RACK SEAL INSTALLER	J-29708
11:	PUMP PULLEY REMOVER	**J 25034-B**
12:	PUMP PULLEY INSTALLER	J-25033-B
13:	PRESSURE GAGE	J-5176-C
14:	PRESSURE GAGE ADAPTER	J-5176-20

Fig. 3B9-15 Special Tools

SECTION 3C

FRONT SUSPENSION

NOTICE: The suspension bolt and nut fasteners are important attaching parts, in that they may affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

Never attempt to heat, quench or straighten any front suspension part.

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UPPER CONTROL ARM 3C-4
LOWER CONTROL ARM 3C-5
STEERING KNUCKLE/WHEEL BEARING 3C-6
STABILIZER 3C-7
UPPER AND LOWER BALL JOINT 3C-8
BALL JOINT INSPECTION 3C-9
SHOCK ABSORBER 3C-10
TRANSVERSE SPRING 3C-11
SPRING BUSHING 3C-12
TORQUE SPECIFICATIONS 3C-13
TOOLS 3C-13

GENERAL INFORMATION

The Corvette front suspension is designed to meet world class sports car durability and ride control, but the paramount concern is **SAFETY.**

Special high strength, forged, aluminum alloy is used for the major components. These include the upper and lower control arms and steering knuckles.

Stability is provided by a high strength, tubular steel (standard) or a solid spring steel (optional) stabilizer bar. Much tighter stabilizer linkage is used.

The Corvette uses a single leaf (fiberglass monoleaf) in place of two conventional coil springs.

The hub and bearing assembly are of long life durable design. The hub has a larger 4 3/4" bolt circle.

The evolution of sports car handling science, finds the front wheel spindle offset being moved rearward from the conventional location. This displacement provides superior directional sense. The combination of +6° caster, and spindle offset, achieves an effect similar to a more positive caster, but provides matchless response.

1. **ARM,** Frt Upr Cont-LH
2. **NUT,** Upr Cont Arm
3. **BALL STUD,** Strg Knu Upr Cont Arm
4. **WASHER,** Strg Knu Upr Cont Arm Ball Stud
5. **PIN,** Cotter (1/8" x 1-1/2")
6. **NUT,** Strg Knu Upr Cont Arm Ball Stud
7. **NUT, Hex Slotted (M12 x 1.25 x 13)**
8.
9. **BOLT,** Hex (M10 x 1.5 x 65)
10. **BOLT,** Frt Whl Mtg
11. **BOLT,** W/Wa, Frt Brk Clpr Mtg
12. **CALIPER,** Frt Brk
13. **ROTOR,** Frt Brk
14. **HUB,** Frt Whl
15. **KNUCKLE,** Strg
16. **WASHER,** Strg Knu Lwr Cont Arm Ball Stud
17. **NUT,** Strg Knu Lwr Cont Arm Ball Stud
18. **BALL STUD,** Strg Knu Lwr Cont Arm
19. **ARM,** Frt Lwr Cont-LH
20. **NUT,** Hex Flg (M8 x 1.25)
21. **BOLT,** Frt C/Mbr, Hex Flg Hd (M8 x 1.25 x 20)
22. **PROTECTOR,** Frt Spr
23. **PAD,** Frt Spr
24. **NUT,** Hex (M10 x 1.5)
25. **RETAINER,** Frt Spr
26. **SPRING,** Frt
27. **CUSHION,** Frt Spr
28. **BEARING,** Frt Spr
29. **SEAT,** Frt Spr
30. **BOLT,** Hex Flg Hd (M8 x 1.25 x 25)
31. **SHIM,** Frt Spr Ret
32. **BRACKET,** Frt S/Abs Lwr
33. **BOLT,** Hex Flg Hd
34. **INSULATOR,** Frt Stab Shf Link Lwr
35. **BOLT,** Hex (M10 x 1.5 x 60)
36. **INSULATOR,** Frt Stab Shf Link Upr
37. **LINK,** Frt Stab Shf
38. **BOLT,** Frt Spr Ret
39. **CLAMP,** Frt Stab Shf Insl
40. **INSULATOR,** Frt Stab Shf
41. **BRACKET,** Frt Stab Shf
42. **SHAFT,** Frt Stab
43. **WASHER,** Frt Upr Cont Arm
44. **SHIM,** Frt Upr Cont Arm
45. **NUT,** Hex Flanged Prev Torq (M10 x 1.5) (Cad 10)
46. **REINFORCEMENT,** Frt Shock Tower
47. **NUT,** Spr "U" Multi-Th (M8 x 1.25)
48. **BOLT,** Hex Flg Hd (M10 x 1.5 x 45)
49. **BOLT,** Frt Upr Cont Arm
50. **FRAME,** Drivetrain & Frt Susp
51. **SHIM,** Drivetrain & Frt Susp Frm (1 mm as req'd)
52. **TOWER,** Frt S/Abs
53. **NUT,** Hex Prev Torq (M10 x 1.5)
54. **RETAINER,** Frt S/Abs Insl
55. **INSULATOR,** Frt S/Abs Upr
56. **INSULATOR,** Frt S/Abs Lwr
57. **SPACER,** Drivetrain & Frt Susp Frm
58. **ABSORBER,** Frt Shk
59. **NUT,** Frt S/Abs Lwr Mtg
60. **WASHER,** Frt Upr Cont Arm
61. **NUT,** Hex Flg Prev Torq (M12 x 1.75)
62. **GEAR,** Hyd Strg R & Pinion
63. **BOLT,** Hex Flg Hd (M8 x 1.25 x 50)
64. **NUT,** Hex Flg Prev Torq (M12 x 1.75)
65. **WASHER,** Frt Lwr Cont Arm (M13 ID 24 OD 3 Thk)
66. **BOLT,** Frt Lwr Cont Arm
67. **WASHER,** Upper Shock
68. **SEAL,** Steering Knuckle O-Ring

Fig. 3C-1 Part List

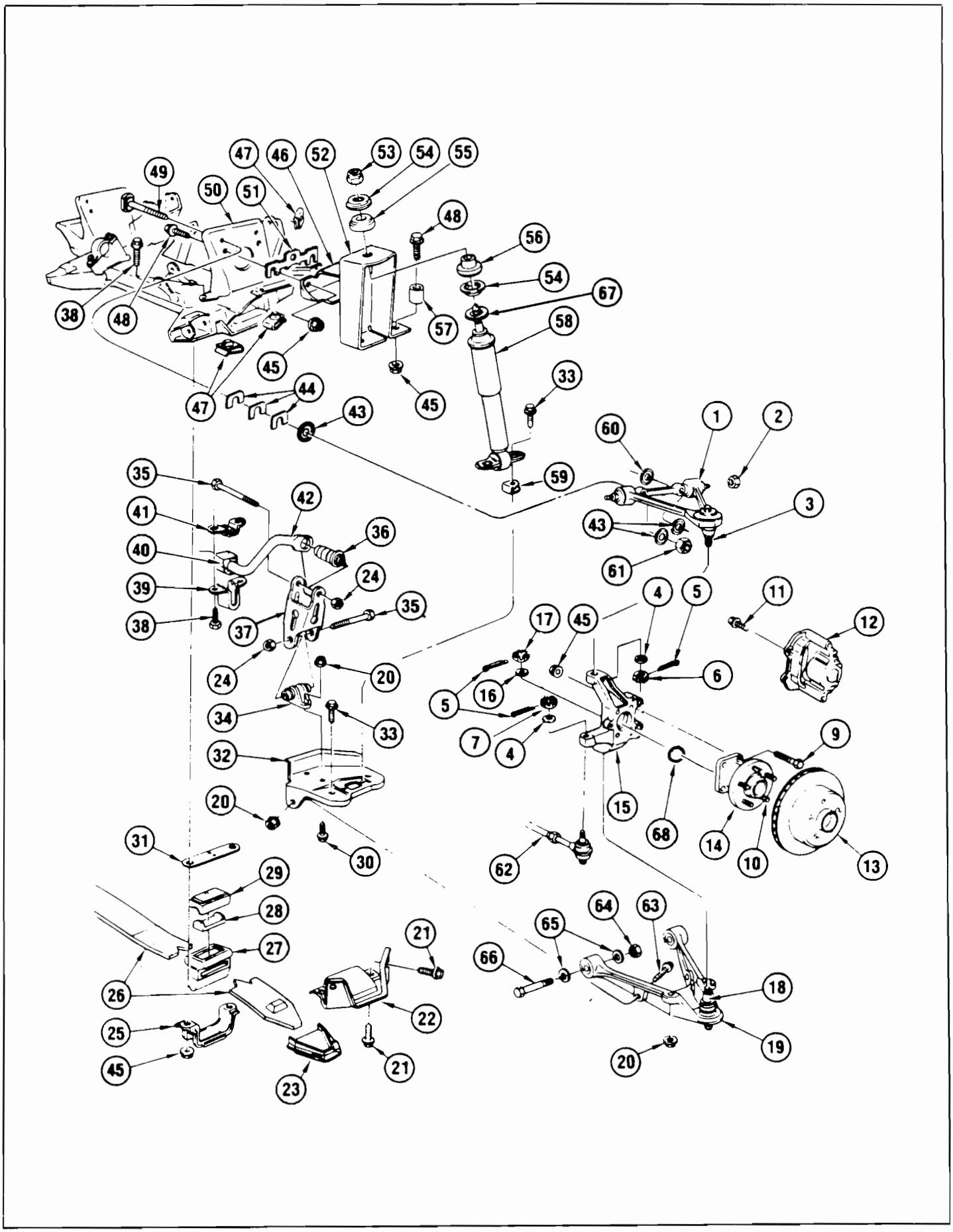


Fig. 3C-2 Front Suspension Explode

USE CAUTION WHEN WORKING NEAR THE BRAKE SENSING SYSTEM. SEE SECTION 5E.

Remove

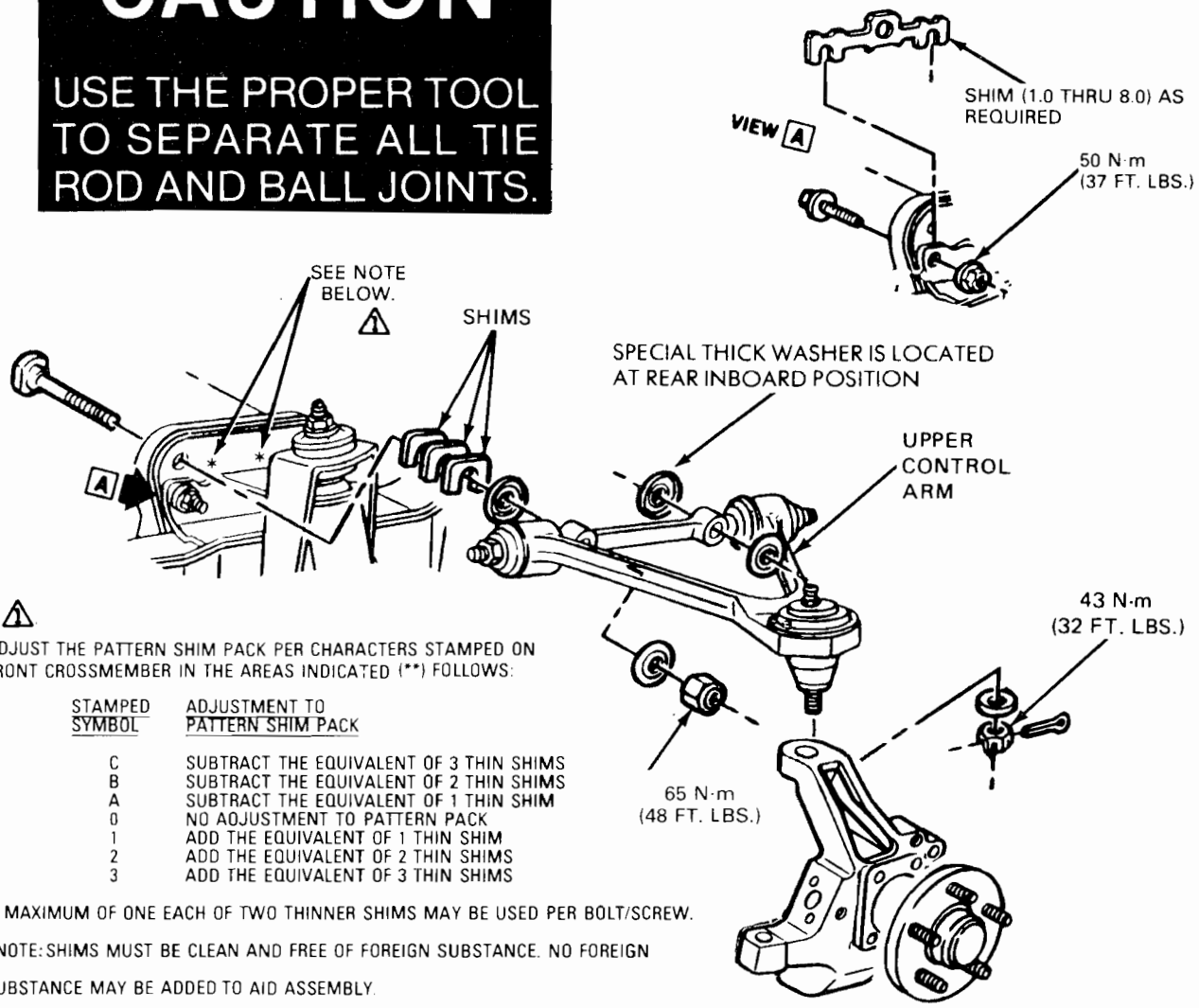
1. Raise vehicle and remove wheel and tire.
2. Support lower control arm using jack stand.
3. Using tool J-33436 disconnect upper ball joint from knuckle.
4. Remove upper control arm as shown.

CAUTION

USE THE PROPER TOOL TO SEPARATE ALL TIE ROD AND BALL JOINTS.

Install

1. Install control arm as shown.
2. Torque nuts to specifications.
3. Cotter pin at ball joint must be installed from rear to front. Do not back off nut for cotter pin insertion.
4. Check front alignment. Adjust if necessary.



1 ADJUST THE PATTERN SHIM PACK PER CHARACTERS STAMPED ON FRONT CROSSMEMBER IN THE AREAS INDICATED (**) FOLLOWS:

STAMPED SYMBOL	ADJUSTMENT TO PATTERN SHIM PACK
C	SUBTRACT THE EQUIVALENT OF 3 THIN SHIMS
B	SUBTRACT THE EQUIVALENT OF 2 THIN SHIMS
A	SUBTRACT THE EQUIVALENT OF 1 THIN SHIM
0	NO ADJUSTMENT TO PATTERN PACK
1	ADD THE EQUIVALENT OF 1 THIN SHIM
2	ADD THE EQUIVALENT OF 2 THIN SHIMS
3	ADD THE EQUIVALENT OF 3 THIN SHIMS

A MAXIMUM OF ONE EACH OF TWO THINNER SHIMS MAY BE USED PER BOLT/SCREW.

NOTE: SHIMS MUST BE CLEAN AND FREE OF FOREIGN SUBSTANCE. NO FOREIGN SUBSTANCE MAY BE ADDED TO AID ASSEMBLY.

A. MAINTAIN A MINIMUM OF ONE FULL THREAD LENGTH BEYOND NUT AFTER ASSEMBLY (NOT INCLUDING CHAMFER).

B. DIFFERENCE BETWEEN FRONT AND REAR SHIM PACK MUST NOT EXCEED 10.2 mm.

IF THESE REQUIREMENTS CANNOT BE MET, IT INDICATES A QUALITY DEFICIENCY IN A COMPONENT PART THAT MUST BE CORRECTED.

Fig. 3C-3–Upper Control Arm

Remove

1. Raise vehicle and remove wheel and tire.
2. Remove spring protector.
3. Using tool J-33432 compress spring.
4. Remove lower shock bracket.
5. Using tool J-33436 disconnect lower ball joint.
6. Remove lower control arm.

USE CAUTION WHEN WORKING NEAR THE BRAKE SENSING SYSTEM. SEE SECTION 5E.

Install

1. Install lower control arm to front crossmember.
2. Hold suspension at curb height and torque bolt to specification. Retain suspension at curb height. Do not allow it to move below rebound.
3. Install shock absorber bracket to control arm. Torque nuts to specifications.
4. Install ball joint to knuckle.
5. Loosen spring and remove tool.
6. Install spring protector.
7. Install wheel and tire and lower vehicle.

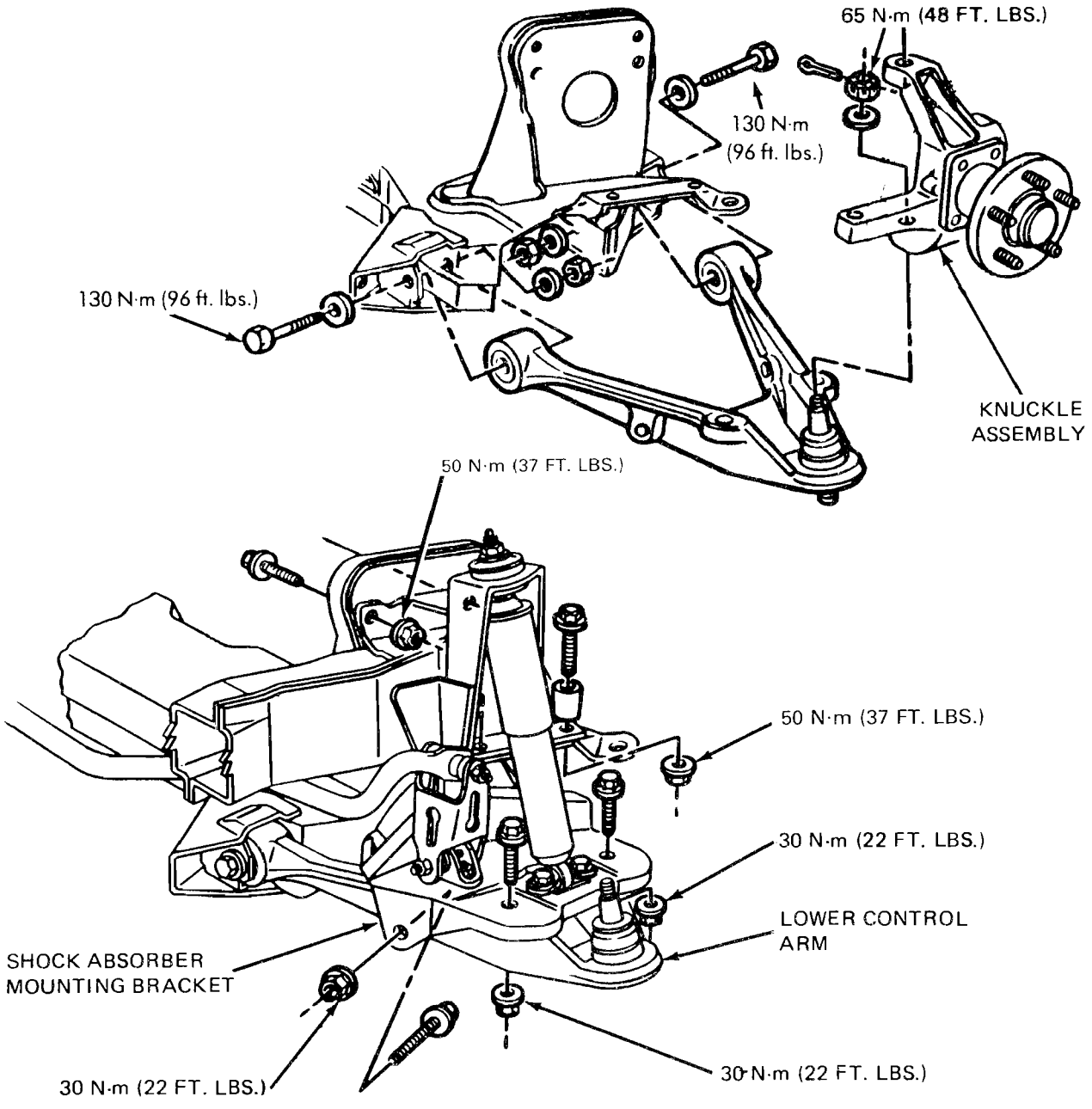


Fig. 3C-4–Lower Control Arm

Remove

1. Hoist vehicle and remove wheel and tire.
2. Remove brake caliper. (See Section 5).
3. Remove hub and bearing assembly.
4. Support lower control arm using jack stand.
5. Disconnect brake sensor. (See Section 5E).
6. Disconnect upper and lower ball joint using tool J-33436-9.
7. Disconnect steering ball joint.
8. Remove knuckle.

Install

1. Reverse removal procedure.
2. Torque nuts and screws to specifications.
3. When installing ball joints and tie rod end to knuckle, do not back off nut for cotter pin insertion.
4. Install wheel and tire and lower vehicle.
5. Torque wheel nuts to 110 N·m (80 ft. lbs.).

USE CAUTION WHEN WORKING NEAR THE BRAKE SENSING SYSTEM. SEE SECTION 5E.

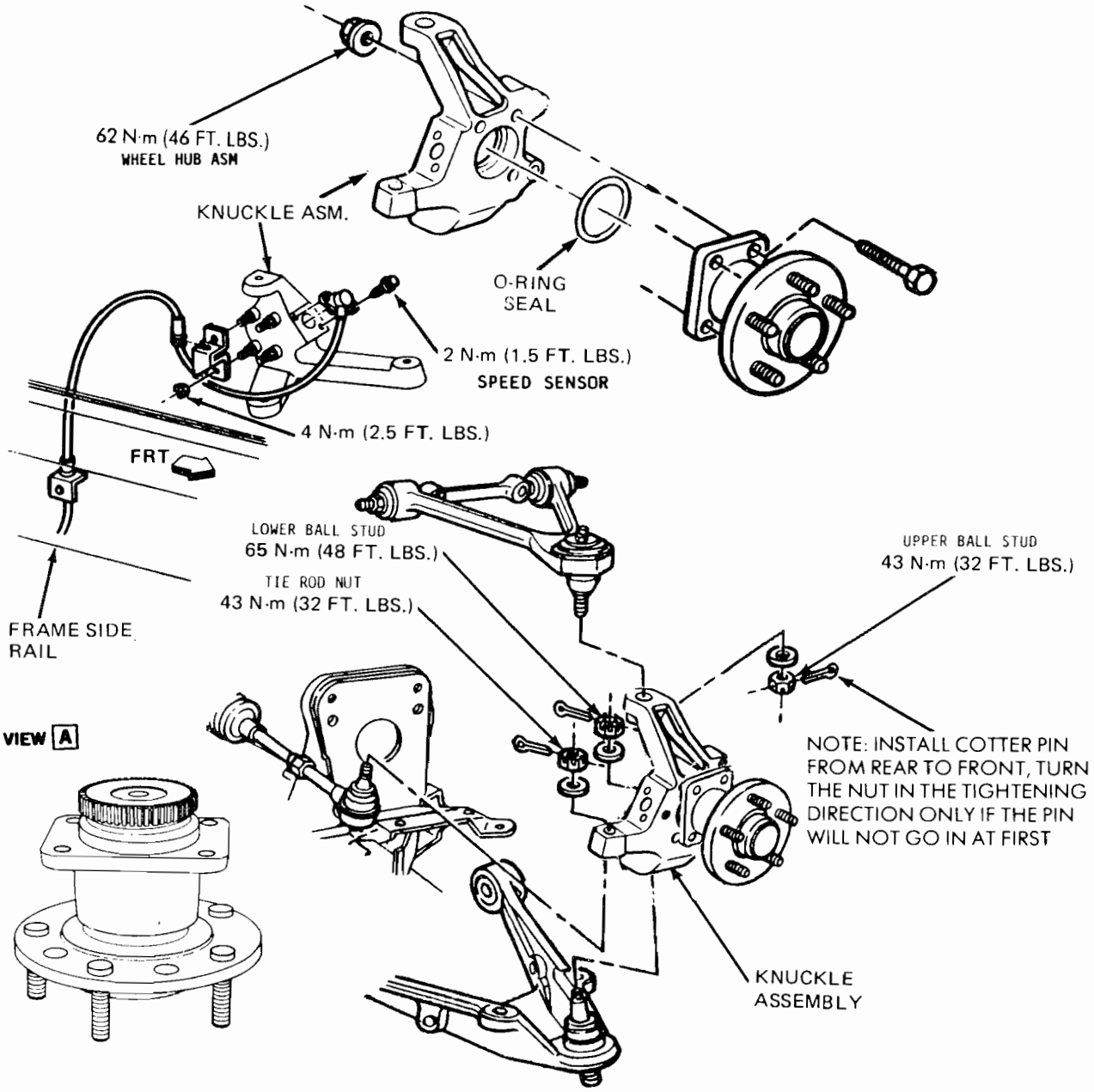


Fig. 3C-5–Steering Knuckle, Bearing and Hub

Remove

1. Remove parts as shown.

Install

1. Install parts as shown.
2. Press upper bushing into stabilizer shaft to dimension shown.

NOTE: Assemble link to upper and lower bushings and torque to specifications with front suspension at "Z" trim height. See Alignment section.

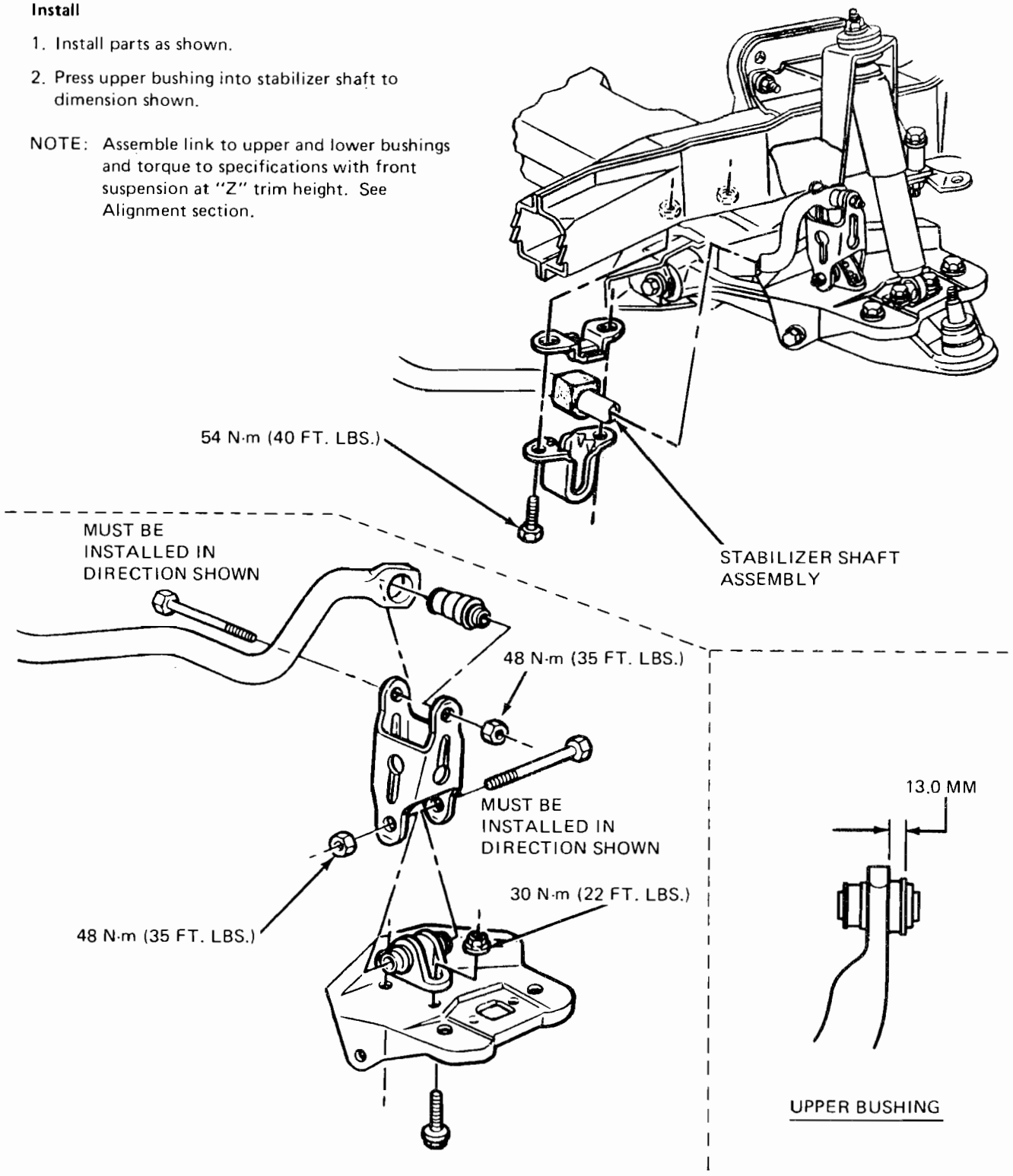


Fig. 3C-6–Front Stabilizer

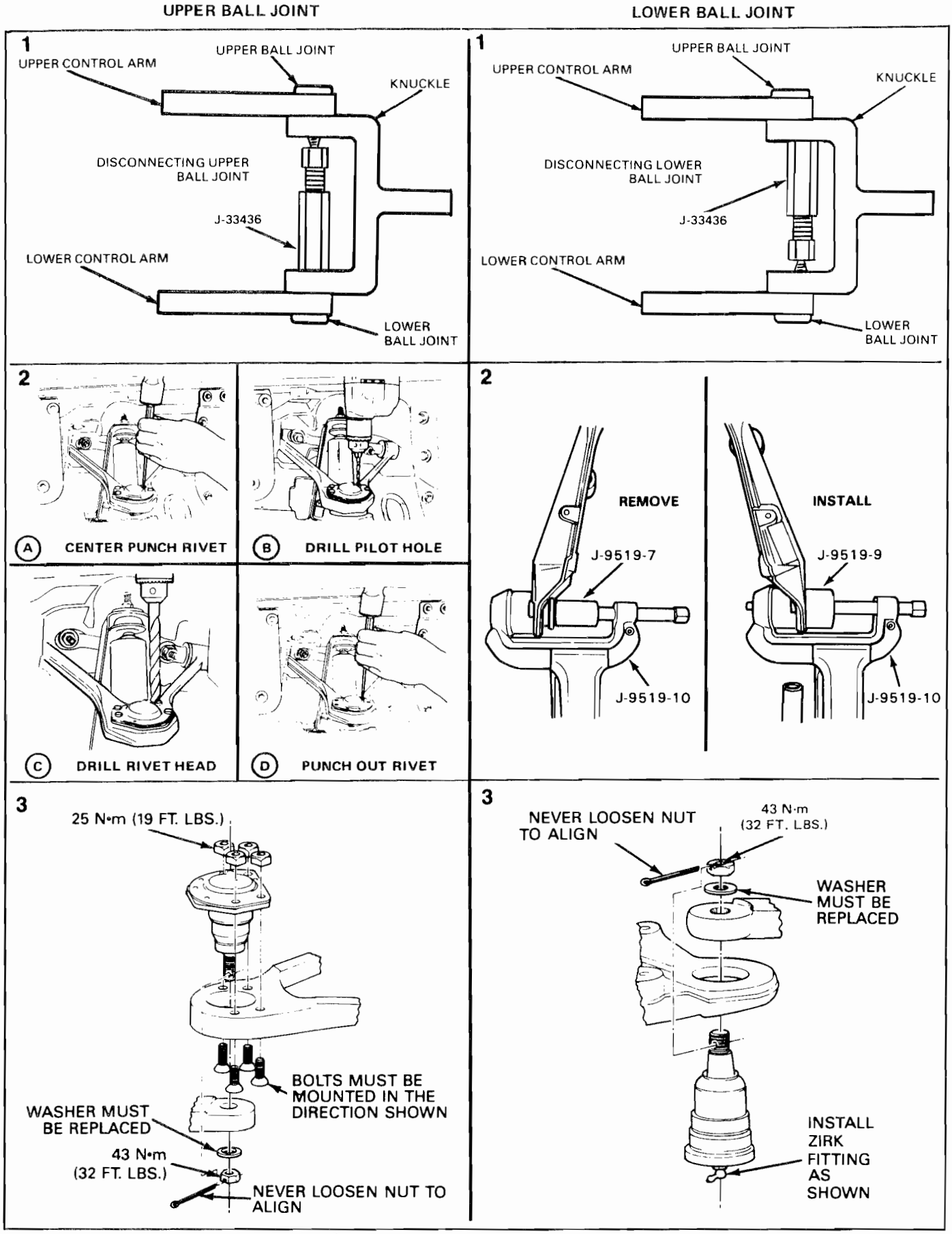


Fig. 3C-7–Upper Ball Joint/Lower Ball Joint

SEAL INSPECTION

Ball Joint seals should be carefully inspected for cuts or tears. Whenever cuts or tears are found, the ball joint MUST be replaced.

CHECKING BALL JOINTS FOR WEAR

Before checking ball joints, the wheel bearings must first be checked for properly adjustment.

Upper Ball Joint

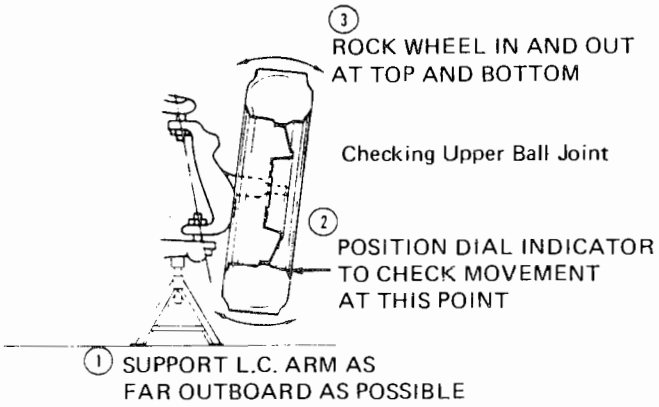
1. Raise the car and position floor stands under the left and right lower control arm as near as possible to each lower ball joint. Car must be stable and should not rock on the floor stands.
2. Position dial indicator as shown in against the wheel rim.
3. Grasp front wheel as shown in and push in on bottom of tire while pulling out at the top. Read gauge, then reverse the push-pull procedure. Horizontal deflection on dial indicator should not exceed 3.18 mm (.125").
4. If dial indicator reading exceeds 3.18 mm (.125") or if ball stud has been disconnected from knuckle assembly and any looseness is detected or the stud can be twisted in its socket with your fingers, REPLACE BALL JOINT.

Lower Ball Joint

The lower ball joint has a VISUAL WEAR INDICATOR. Checking the condition of the ball joint is a simple procedure but must be followed accurately to prevent unnecessary ball joint replacement.

Inspection

Car must be supported by the wheels so that weight of car will properly load the ball joints.



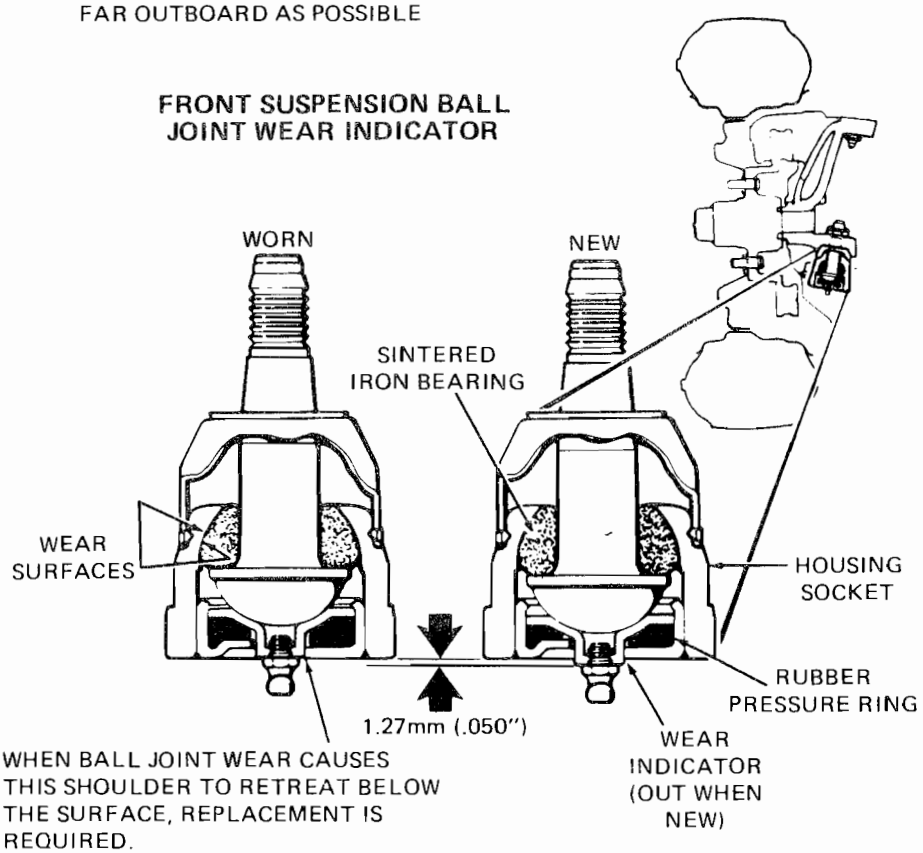
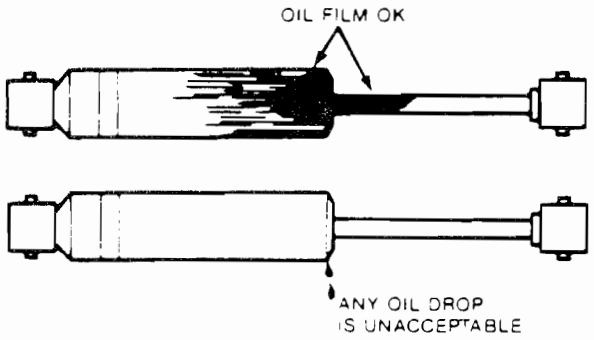


Fig. 3C-8–Ball Joint Inspection

Optional Shock Absorbers

Leakage Diagnosis:

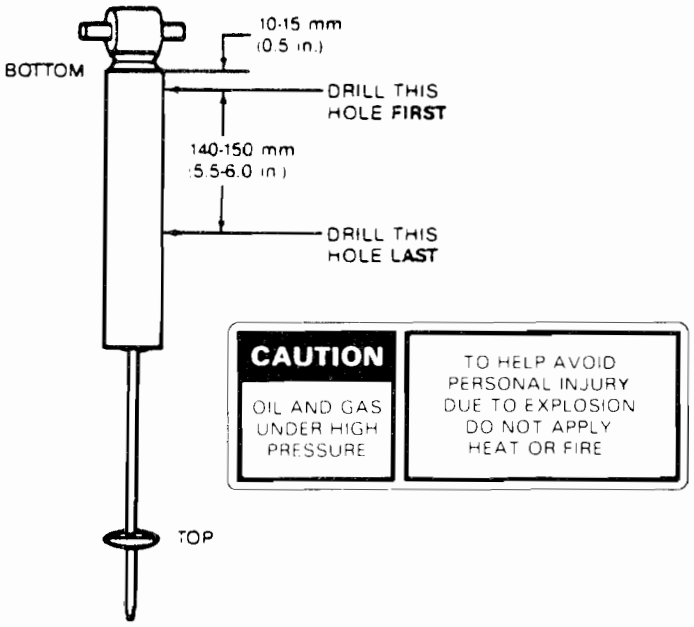
The appearance of oil film on the shock absorber body or piston rod is normal. Any dripping of oil is unacceptable.



Disposal:

Due to the high pressure of gas it is advised that, upon scrapping or disposal of these shock absorbers, the pressure be released. This is carried out as follows:

a. Clamp shock in vise with piston rod pointing down.
b. Measure approx. 10-15 mm (0.5 in.) from bottom of shock and drill an approx. 5 mm hole so the gas can escape.
c. Measure approx. 140-150 mm (5.5-6.0 in.) from first hole and drill an approx. 5 mm hole to facilitate drainage of oil.
d. Drain oil from shock and then dispose of shock.



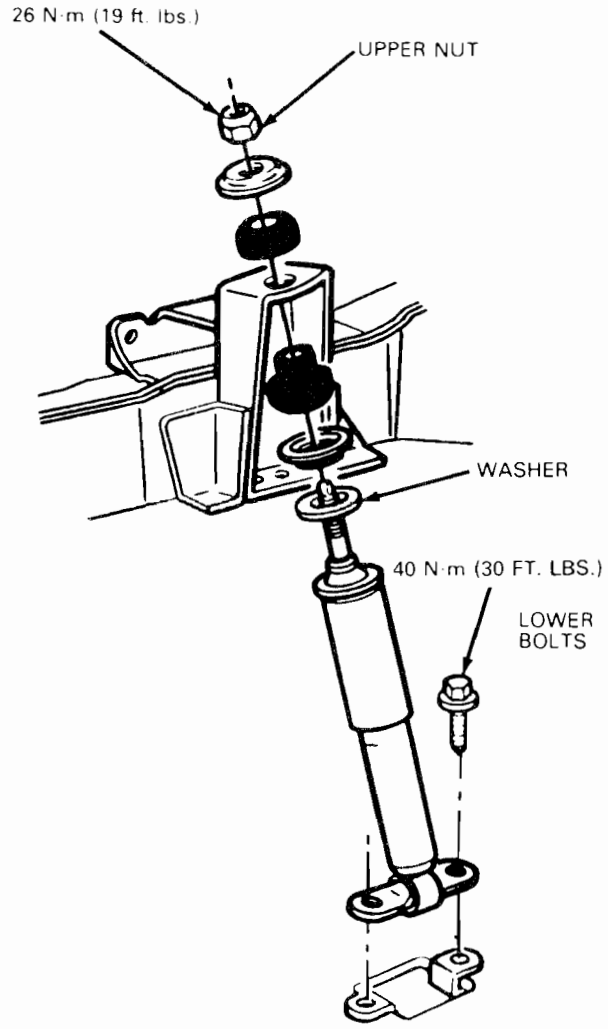
REMOVE AND INSTALL SHOCK ABSORBERS

REMOVE

1. Remove parts as shown.*

INSTALL

1. Install parts as shown.



*IF THE UPPER NUT IS DIFFICULT TO REMOVE, REMOVE WHEELHOUSE PANEL, AS SHOWN BELOW.

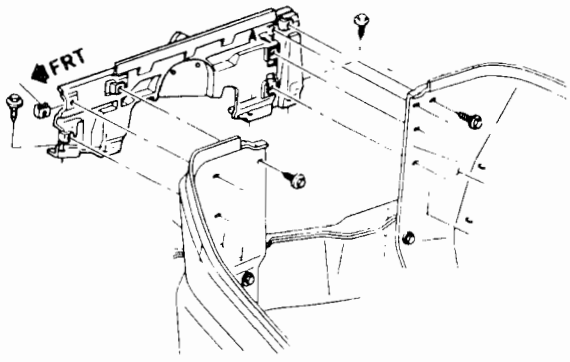


Fig. 3C-9–Shock Absorber

Removal

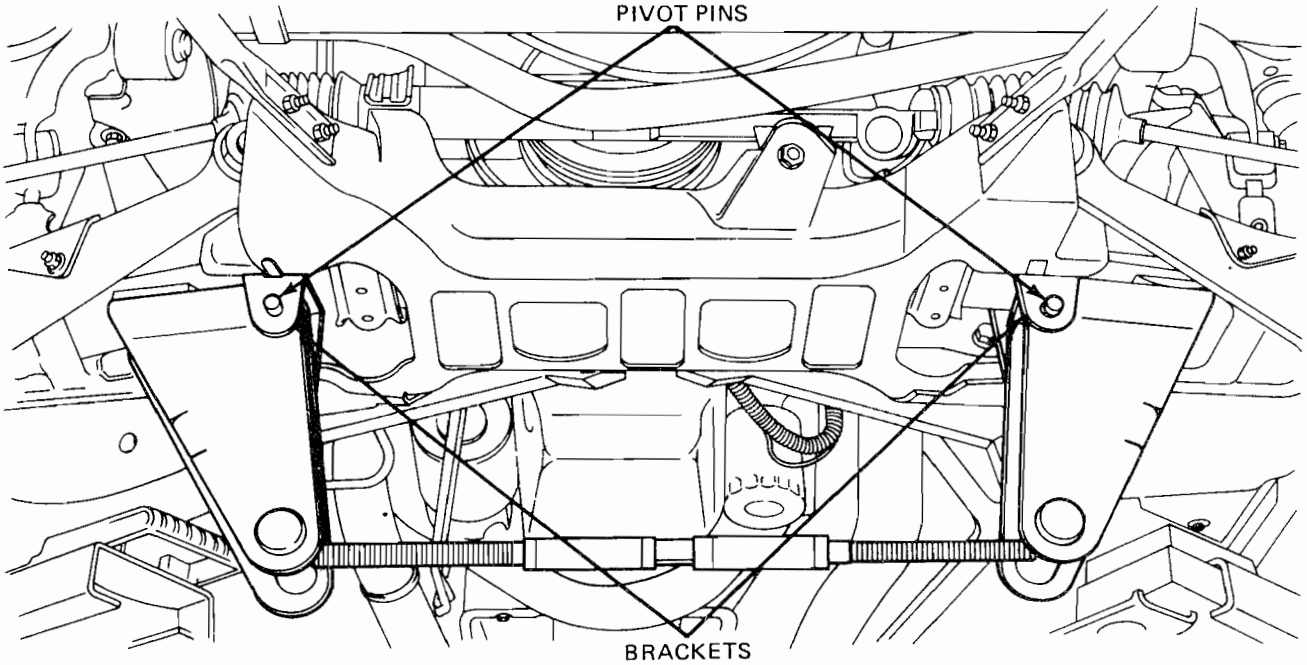
1. Raise the vehicle on a hoist.
2. Remove both wheel and tire assemblies.
3. Remove both spring protectors.
4. Remove the spring mounting nuts.
5. Install spring compressing tool J-33432.
6. Disconnect both lower ball joints using tool J-33436.
7. Compress spring.
8. Remove the lower shock stabilizer bracket from lower control arm (one side only).
9. Remove the lower shock and stabilizer to bracket attaching bolts. Remove bracket from lower control arm (one side only).
10. Release and remove compressing tool.
11. Pull both lower control arms down to full travel using another person.
12. Remove spring using care not to scratch the spring.

Installation

1. Install the spring by reversing the removal procedure.
2. Torque all nuts and bolts to specifications.
3. Check the vehicle's wheel alignment.

Note: During removal and installation of transverse spring take care to prevent damage.

Make sure shims are installed per chart on 3c-12 for each color code.



NOTE: PIVOT PINS ARE REMOVED SO THAT THE BRACKET MAY BE PLACED OVER THE TOP OF THE SPRING.

Fig. 3C-10–Transverse Front Spring

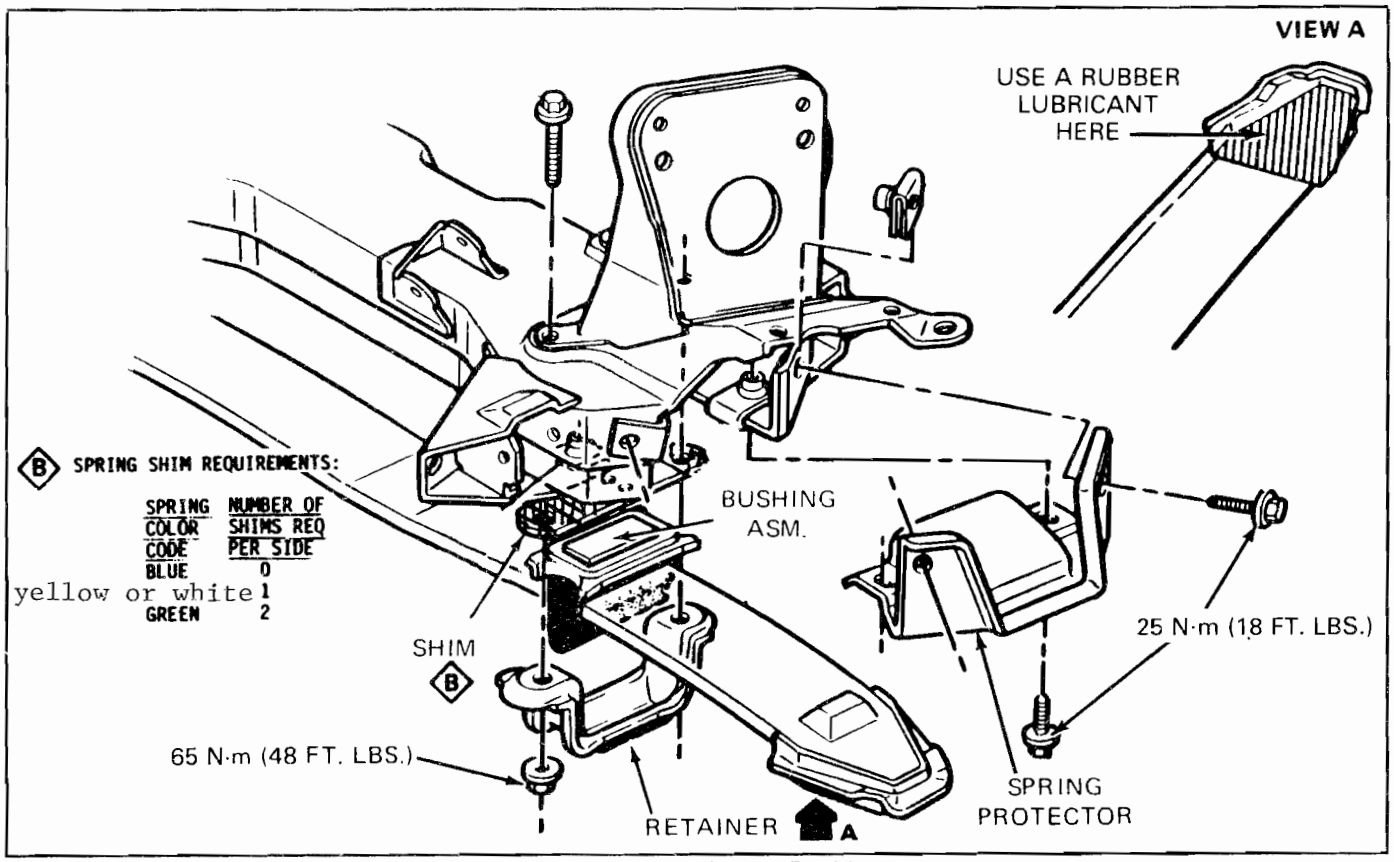


Fig. 3C-11–Front Spring Bushing

TORQUE SPECIFICATIONS	N·m	Ft. Lbs.
Upper Control Arm to Upper Ball Joint	43	32
Lower Control Arm to Lower Ball Joint	65	48
Upper Control Arm Shaft to Crossmember	85	63
Lower Control Arm Shaft to Crossmember	130	96
Spring Protector to Crossmember	25	18
* Spring Retainer	65	48
Shock Absorber to Lower Control Arm	40	30
Shock Absorber to Frame	30	22
Shock Absorber Bracket to Lower Control Arm	30	22
* Stabilizer Clamp to Frame	54	40
* Stabilizer Link	48	35
Stabilizer Bushing and Bracket Assembly to Lower Control Arm	30	22

* Vehicle must be "on-the-ground" for final torque.

Special Tools

Description	Tool Number
Ball Joint Disconnector	J-33436
Transverse Spring Remover and Installer	J-33432-4
Lower Ball Joint Remover	J-9519-10

Fig. 3C-13–Torque Specifications/Tools

SECTION 3D

REAR SUSPENSION

NOTICE: All rear suspension fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in a major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts.

NOTICE: There is to be NO heating, welding or hammering, as it may result in extensive damage and weakening of metal.

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GENERAL DESCRIPTION

The rear suspension features a light weight fiberglass transverse spring mounted to the fixed differential carrier. Light weight aluminum components such as the knuckles, upper and lower control arms, camber control support rods, differential carrier cover beam and the drive line support beam are used throughout the rear suspension. Each wheel is mounted to a five link independent suspension. The five links are identified as the wheel drive shaft, camber control support rod, upper and lower control arms and tie rod. The advantages of this suspension unit include a reduction of unsprung weight as well as an overall weight reduction. In addition, wheel tramp is eliminated, and handling is improved because of the independent action of each rear wheel.

The axle drive shafts and the camber control support rods act together in maintaining an almost constant camber throughout the entire arc of wheel travel. Fore-aft motion of the wheel is controlled by the upper and lower control arms. Each rear wheel has a short spindle, hub and bearing assembly, and knuckle contained at the rear of the upper and lower control arms. The knuckle also acts as a mount for the parking brake backing plate assembly, rear spring link, and shock absorber lower attachment.

Several techniques can be employed to achieve this independent wheel movement. A five-link independent rear suspension is used on Corvettes. The five-link design, as shown, can be compared to a right angle. The wheel is located at the right angle formed by the control arms and the "lateral links" (the camber control support rod and the rear wheel drive shaft). The points of the triangle are hinged to provide up-down wheel travel. The solid links thus force the wheel to travel through a controlled arc with for-aft position determined by the control arms and lateral position held by the lateral links.

Aside from controlling wheel location, each portion of the suspension has additional functions. The control arms and knuckle support the brake caliper, thus, all torque and braking tractive forces are transmitted through the arms. This design allows the lateral forces to propagate through the links to the fixed differntial, and through the rubber bushings in the cover beam to the frame.

The lateral links also maintain the camber curve of the wheel through jounce and rebound. The overall result of the lateral link geometry, is to maintain the wheel in a near vertical position at all times.

Direct double-acting shock absorbers are attached at the upper end to a frame bracket and at the lower end to the knuckle. The shock absorber's job is

to maintain wheel contact with the road surface under most all surface changes.

Optional pressurized gas (nitrogen) shocks are available. They reduce aeration (foaming) of the shock fluid, resulting in unlimited damping control. It also reduces impact harshness and improved road isolation which can return the "Big Car" ride feel. The gas shock improves control by keeping the tire on the road. They reduce "crash-thru" at extremes of jounce and rebound. The rear axle hub and bearing is a sealed, maintenance free unit.

ON VEHICLE SERVICE

REAR HUB AND BEARINGS

(Figures 3D-1 and 5)

Removal

1. Raise vehicle.
2. Remove wheel and tire.
3. Remove brake caliper. See the Brake Section 5.
4. Remove brake rotor.
5. Disconnect transverse spring from the knuckle.
6. Using J-34161 (Torx #45), remove the hub and bearing mounting bolts.
7. Remove cotter pin, spindle nut and washer.
8. Remove hub and bearing from the vehicle and support the parking brake backing plate.

Installation

To install, reverse the removal procedures and include the following:

1. Inspect the spindle seal and replace if necessary.
2. Torque all nuts and bolts to specification.

NOTICE: Vehicle should not rest on tires or be moved until spindle nut is properly torqued.

3. Check and adjust rear suspension alignment as necessary. Refer to Rear Wheel Alignment in Section 3A of this manual.

REAR WHEEL SPINDLE

(Figures 3D-1 and 5)

Removal

1. Raise vehicle.
2. Remove wheel and tire.
3. Disconnect transverse spring from the knuckle.
4. Remove cotter pin, spindle nut and washer.
5. Remove the trunnion straps at the spindle yoke. Push out on the knuckle and separate axle shaft from the spindle.
6. Remove the spindle from the hub and bearing.

Installation

To install, reverse the removal procedures and include the following:

1. Remove parking brake plate. See the Brake Section 5.
2. Inspect the spindle seal and replace if necessary.
3. Torque all nuts and bolts to specifications.
4. Check and adjust rear suspension alignment as necessary. Refer to Rear Wheel Alignment in Section 3A of this manual.

REAR AXLE KNUCKLE

(Figures 3D-1,2,3,4,5,7, and 9)

Removal

1. Raise vehicle.
2. Remove wheel and tire.
3. Disconnect brake sensor (See Brake Section 5E).
4. Disconnect transverse spring from the knuckle.
7. Disconnect parking brake cable from the backing plate.
8. Remove cotter pin, spindle nut and washer.
9. Using J-34161 (Torx #55), remove the hub and bearing bolts.
10. Remove hub and bearing with parking brake backing plate from knuckle.
11. Disconnect stabilizer bar from the knuckle.
12. Disconnect tie rod end from the knuckle.
13. Disconnect shock absorber from the knuckle. Use a backup wrench on the mounting stud. Torque to 120 N·m (89 ft. lbs.).
14. Disconnect spindle support rod from the knuckle.
15. Disconnect upper and lower control arms from the knuckle.
16. Lower the knuckle assembly and slide spindle out from the hub and bearing.

Installation

To install, reverse the removal procedures and include the following:

1. Install a new spindle seal.
2. Torque all nuts and bolts to specifications.
3. Check and adjust the rear wheel alignment as necessary.

Use caution when working near the brake sensing system (See Section 5E). Refer to Rear Wheel Alignment in Section 3A of this manual.

SPINDLE SUPPORT ROD

(Figure 3D-2)

Removal

1. Raise vehicle.
2. Scribe mark on cam bolt and mounting bracket so they can be realigned in the same position.
3. Remove cam bolt and separate spindle support rod from the mounting bracket.
4. Remove the spindle support rod bolt at the knuckle and remove rod.

Installation

To install, reverse the removal procedures and include the following:

1. Torque all nuts and bolts to specification.
2. Check and adjust rear wheel alignment as necessary. Refer to Rear Wheel Alignment in Section 3A of this manual.

UPPER/LOWER CONTROL ARMS

(Figure 3D-2)

Removal

1. Raise vehicle.
2. Disconnect transverse spring at knuckle.
3. Remove the control arm nut and bolt at knuckle.
4. Remove control arm nut and bolt at body bracket. Remove arm.

Installation

For installation, reverse the procedure, but include the following step:

1. Torque nuts to specification.

REAR TRANSVERSE SPRING

(Figure 3D-3)

Removal

1. Raise vehicle.
2. Remove one rear wheel and tire.
3. Remove cotter pins, retaining nuts, rubber bushings and link bolt attaching the spring to the knuckles.
4. Remove transverse spring attaching bolts, spacers, insulators and spring from the carrier beam.

Installation

1. Position spring, and insulators to the carrier beam. Install attaching nuts and bolts, and torque to specification.
2. Position spring to knuckles. Install bolts, insulators, and nuts as shown. Tighten nut until slot in nut aligns with hole in bolt and then install cotter pin.
3. Install wheel and tire.
4. Lower vehicle.

REAR AXLE TIE ROD AND/OR ADJUSTER SLEEVE

NOTICE: The rear tie rod assembly has plastic internal bearings. If the vehicle is involved in an accident (rear suspension), check the rear tie rod assembly for lash (looseness). Replace assembly if any lash is found.

(Figure 3D-4)

Removal

1. Raise vehicle.
2. Remove cotter pin and retaining nut from tie rod end at knuckle.
3. Loosen jam nut on tie rod end.
4. Using J-24319-01, separate tie rod end from the knuckle.
5. Remove tie rod end from the adjusting sleeve.

Installation

To install, reverse the removal procedures and include the following:

1. Torque all nuts and bolts to specification.
2. Check and adjust the rear wheel alignment as necessary. Refer to Rear Wheel Alignment in Section 3A of this manual.

REAR AXLE TIE ROD ASSEMBLY

(Figure 3D-4)

Removal

1. Raise vehicle.
2. Remove cotter pin and retaining nut from tie rod end at knuckle.
3. Using J-24319-01, separate tie rod end from knuckle.
4. Remove bolts attaching tie rod assembly to differential carrier.

Installation

To install, reverse removal procedures and include the following:

1. Torque all nuts and bolts to specification.
2. Check and adjust the rear wheel alignment as necessary.

REAR SPRING INSULATORS

(Figure 3D-5)

Removal

1. Raise vehicle.
2. Support the end of spring with a jack stand. Place a block of wood between jack and spring.
3. Remove the cotter pin.
4. Remove the nut and bolt.
5. Replace insulators.

Installation

1. To install, reverse the removal procedure.
2. Snug the castle nut (only necessary torque required to install cotter pin.) Do not back off nut when aligning the cotter pin.

STABILIZER BAR

(Figure 3D-7)

Removal

1. Raise vehicle.
2. Remove spare tire and tire carrier.
3. Disconnect stabilizer bar from knuckles.
4. Remove stabilizer bar bushing retainers, bushings and bar from the vehicle.

Installation

To install, reverse the removal procedures and include the following:

1. Torque all nuts and bolts to specifications.

DRIVELINE SUPPORT

(Figure 3D-6)

Removal

1. Raise vehicle.

Model 67 (convertible) only, requires removal of underbody braces.

2. Remove the complete exhaust system (see Exhaust Section 6F) as an assembly by:
   a. Disconnect A.I.R. pipe at the converter.
   b. Disconnect A.I.R. pipe clamps at exhaust pipe.
   c. Disconnect oxygen sensor electrical lead.

Model 67 (convertible) only, requires removal of exhaust hanger bolts at support.

   d. Remove the bolts attaching the mufflers to the hangers.
   e. Remove hanger bracket at the converter.
   f. Disconnect the exhaust from the exhaust manifold and remove the exhaust system.
3. Carefully support transmission.
4. Remove driveline support attaching nuts and bolts at the differential carrier and transmission extension housing.
5. Remove the propeller shaft. Before removing the propshaft, mark or scribe the assigned polarity of the propshaft trunion to the axle yoke.
6. Remove the driveline support by prying between transmission and support. Remove driveline support from the vehicle.

Installation

To install, reverse the removal procedure and include the following:

1. Align driveline components. To insure proper alignment of the driveline, a clearance of 45mm ± 6mm (1.77″ ± .250″) must be maintained between the top of the support to the underbody and a clearance of 28mm ± 6mm (1.1″ ± .250″) from the right side (passenger side of vehicle) of the support to the side wall.
   Take these measurements directly above and to the right of the propeller shaft front yoke.
2. Apply sealant (see Figure 3D-6) to the mating surfaces of the transmission extension housing, differential carrier and driveline support.
3. Torque all nuts and bolts to specification.

NOTICE: Do not over torque the nuts attaching the driveline support to the transmission. Over torquing can damage the transmission extension housing, bushing and seal and result in fluid leakage Model 67 (convertible) only, refer to Section 10 for the underbody brace installation.

DIFFERENTIAL CARRIER BUSHINGS

(Figures 3D-4 and 8)

Removal

1. Remove the differential carrier see the Axle Section 4B.
2. Install J-34197-1 receiver, bolt, bearing and washer on flange side of bushing (rear side).
3. Install remover J-34197-3 over bolt until seated on bushing (front side).
4. Install long nut J-34197-5 on bolt. Tighten bolt while holding long nut until bushing is pressed out.

Installation

1. Install bolt, bearing and washer on installer (J-34197-2). Install on bushing (flange end) and then place in position (rear side).
2. Install receiver J-34197 on bolt (front side).
3. Install long nut J-34197-5 on bolt. Tighten bolt while holding long nut until bushing is flush.

SHOCK ABSORBERS

(FIGURE 3D-9 and 10)

Removal

If equipped gas shock absorbers, refer to Figure 3D-10 for caution, inspection and disposal instructions.

1. Raise vehicle.
2. Disconnect the shock absorber at the knuckle. Use a backup wrench on the mounting stud nut.
3. Remove upper shock absorber attaching nut and bolt.

Installation

1. Position shock absorber to body bracket. Install attaching nut and bolt, and torque to specification.
2. Position shock absorber to the knuckle. Install washer and nut, and torque to specification. Use a backup wrench on the mounting stud nut.
3. Lower vehicle.

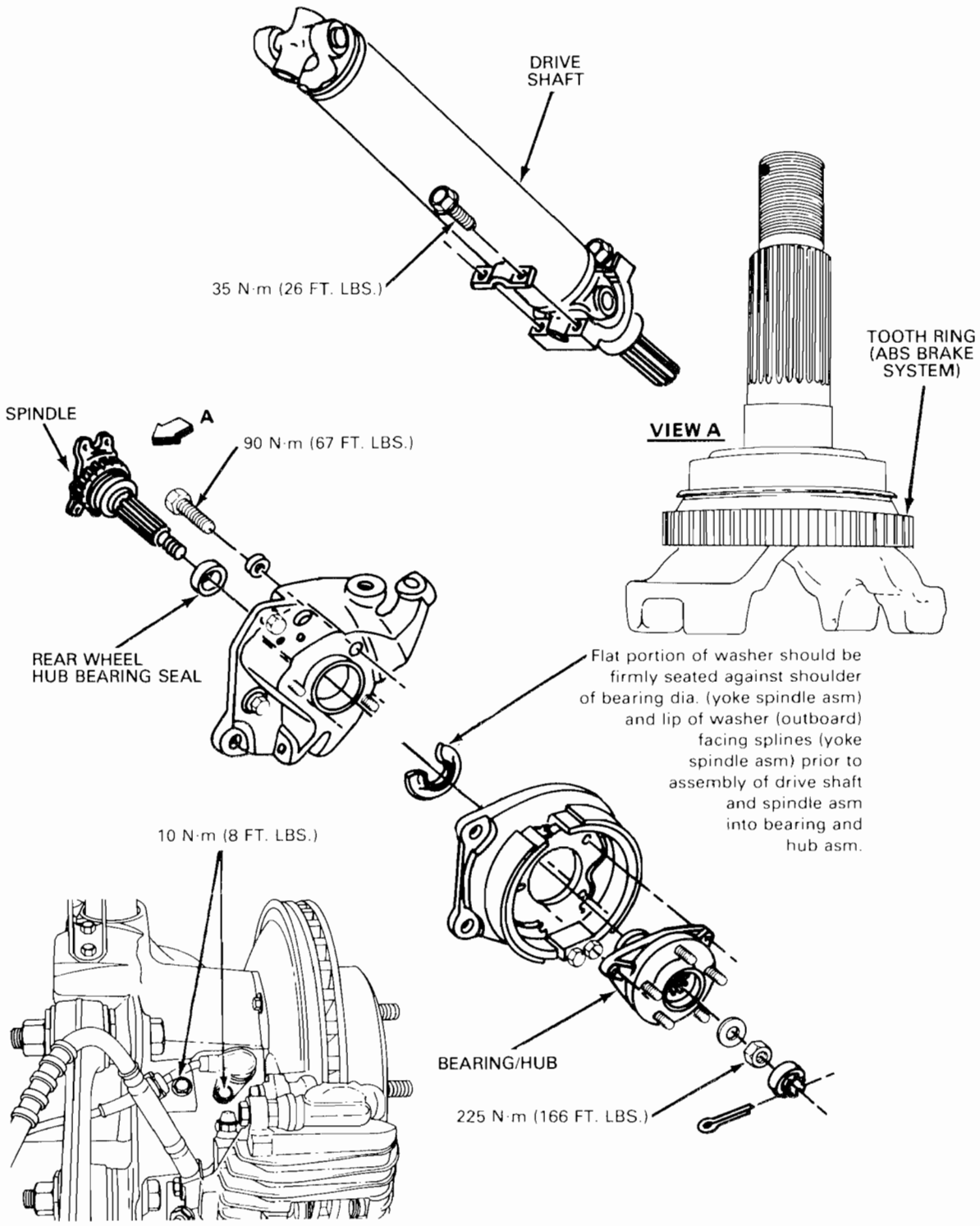
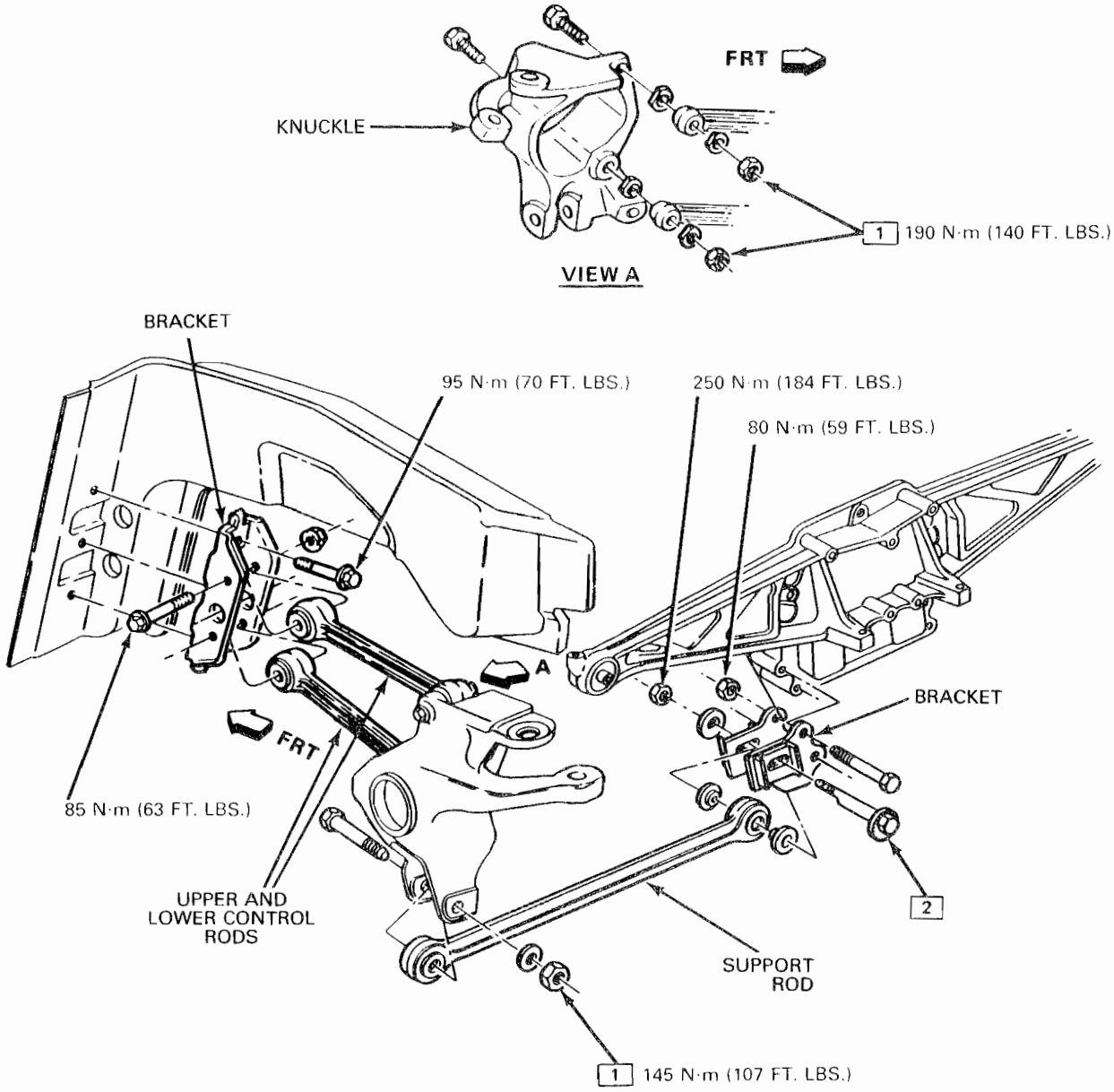


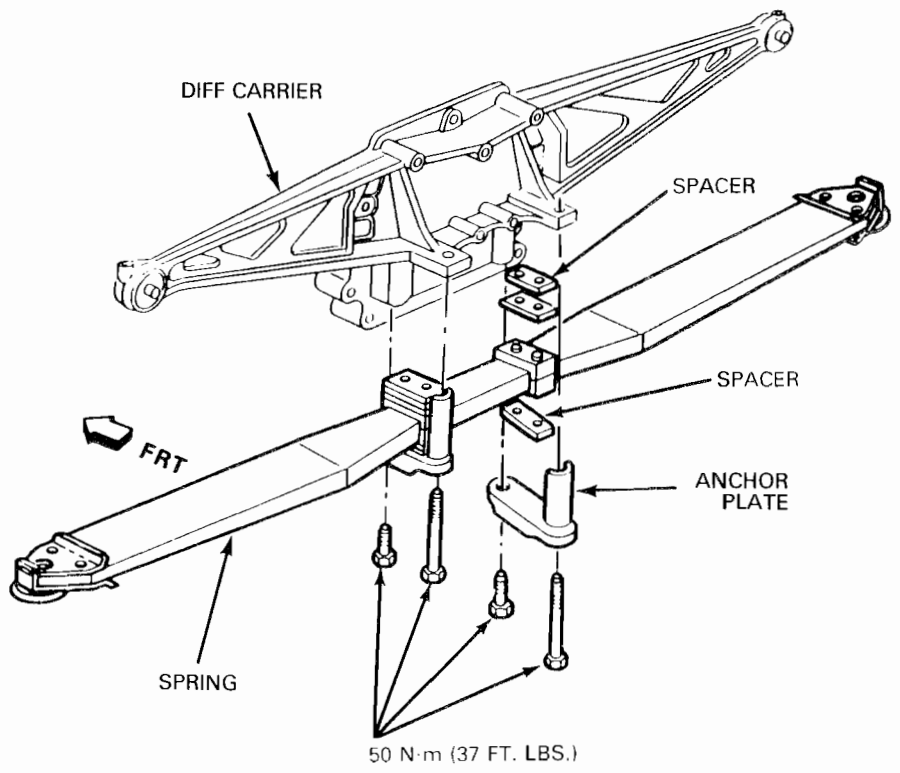
Figure 3D-1 Rear Hub/Bearing and Spindle



1 Must be torqued with rear suspension at "D" height, as shown in Section 3A "Trim Height Chart".

2 See Section 3A "Rear Camber Adjustment".

Figure 3D-2 Knuckle Support/Control Rod



ASSEMBLE SPRING SPACERS AS FOLLOWS:

BASE SPRING
(A) SPRING *
1-14044572 ABOVE SPRING
1-14048950 BELOW SPRING
1-14044572 BELOW SPRING
(B) SPRING (GREEN CODE)
1-14044572 ABOVE SPRING
1-14048950 ABOVE SPRING
1-14044572 BELOW SPRING

* yellow or white code.

OPTION
(A) SPRING *
1-14084056 ABOVE SPRING
2-14048950 BELOW SPRING
(B) SPRING (GREEN CODE)
1-14084056 ABOVE SPRING
1-14048950 ABOVE SPRING
1-14048950 BELOW SPRING

CONVERTIBLE
(A) SPRING *
2-14044572 ABOVE SPRING
1-14093185 ABOVE SPRING
1-14084056 BELOW SPRING

Figure 3D-3 Rear Spring

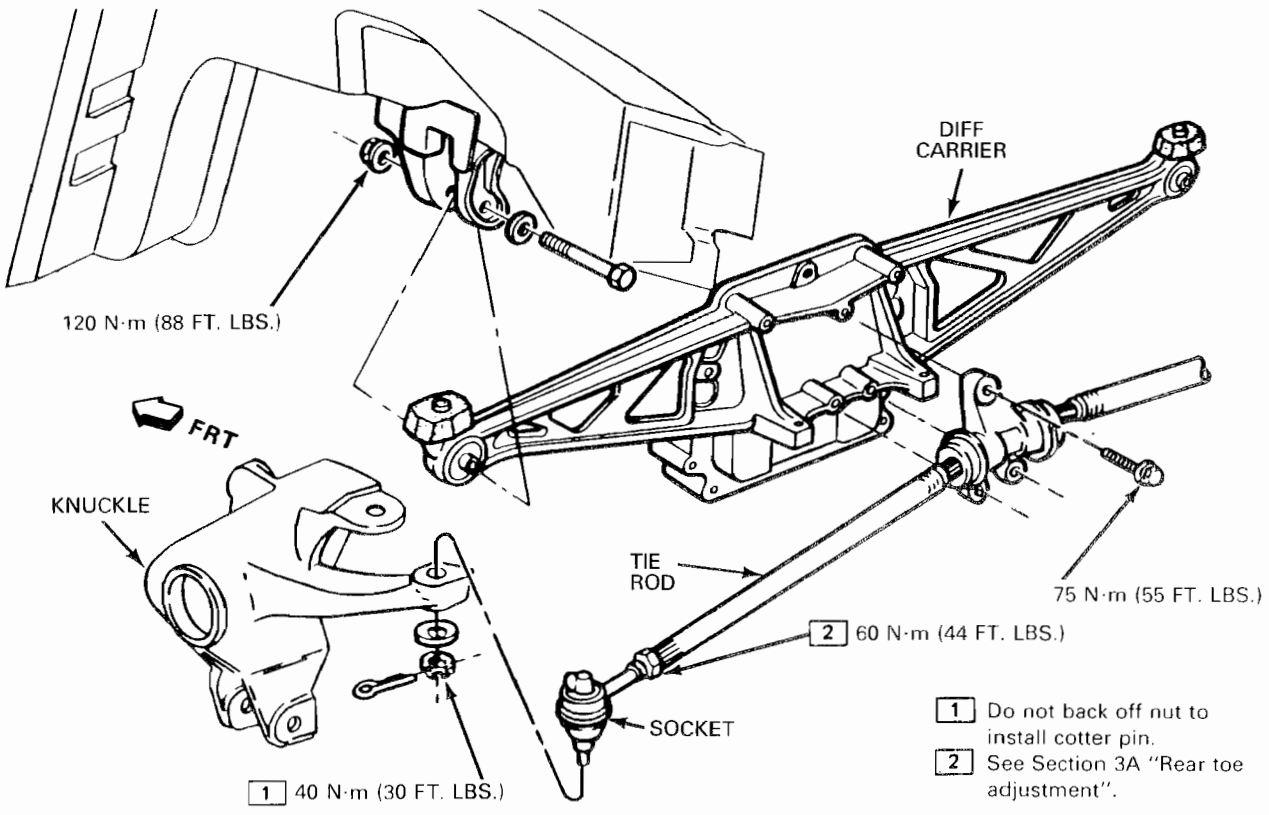


Figure 3D-4 Rear Tie Rod/Adj Sleeve

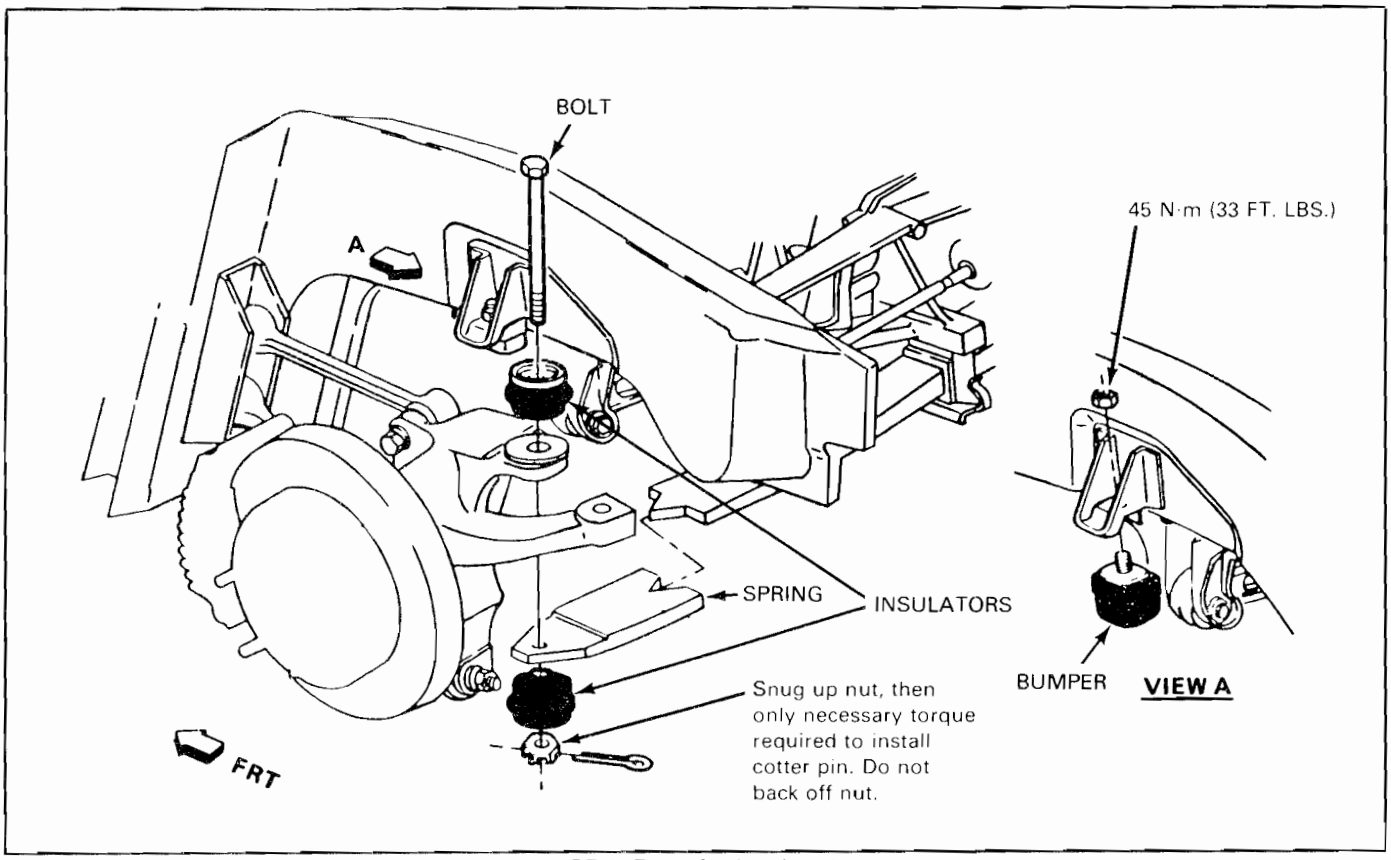
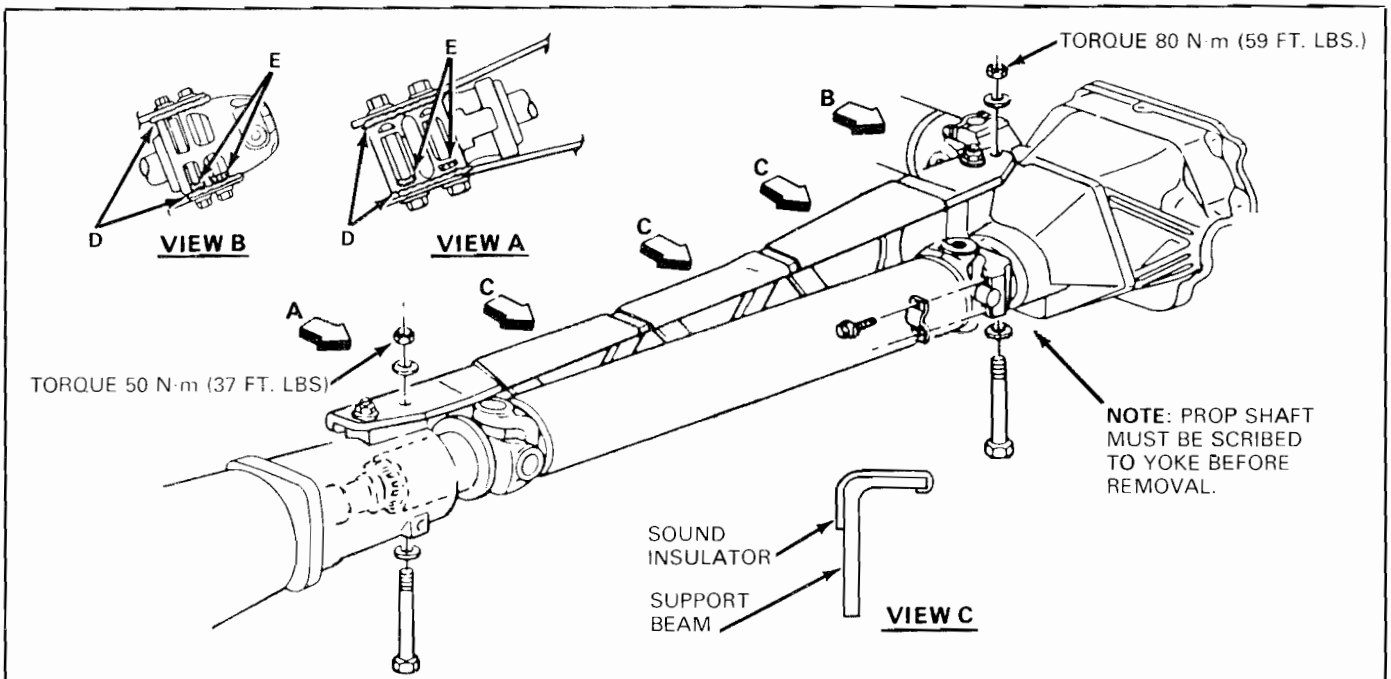


Figure 3D-5 Rear Spring Insulators



SEALER
Apply a bead of sealer around the top and bottom mating surfaces of driveline to axle and transmission extension at points **D**, and also to the cavity around the bolts at points **E**. Use Sealer #9636067 or equivalent.

INSULATOR
Remove insulator with flat blade scraper, clean surface. Install insulator by removing the backing on the insulator and pressing the insulator as shown in view **C** to obtain adhesion to support beam. Trim off any overhang.

Figure 3D-6 Driveline Support

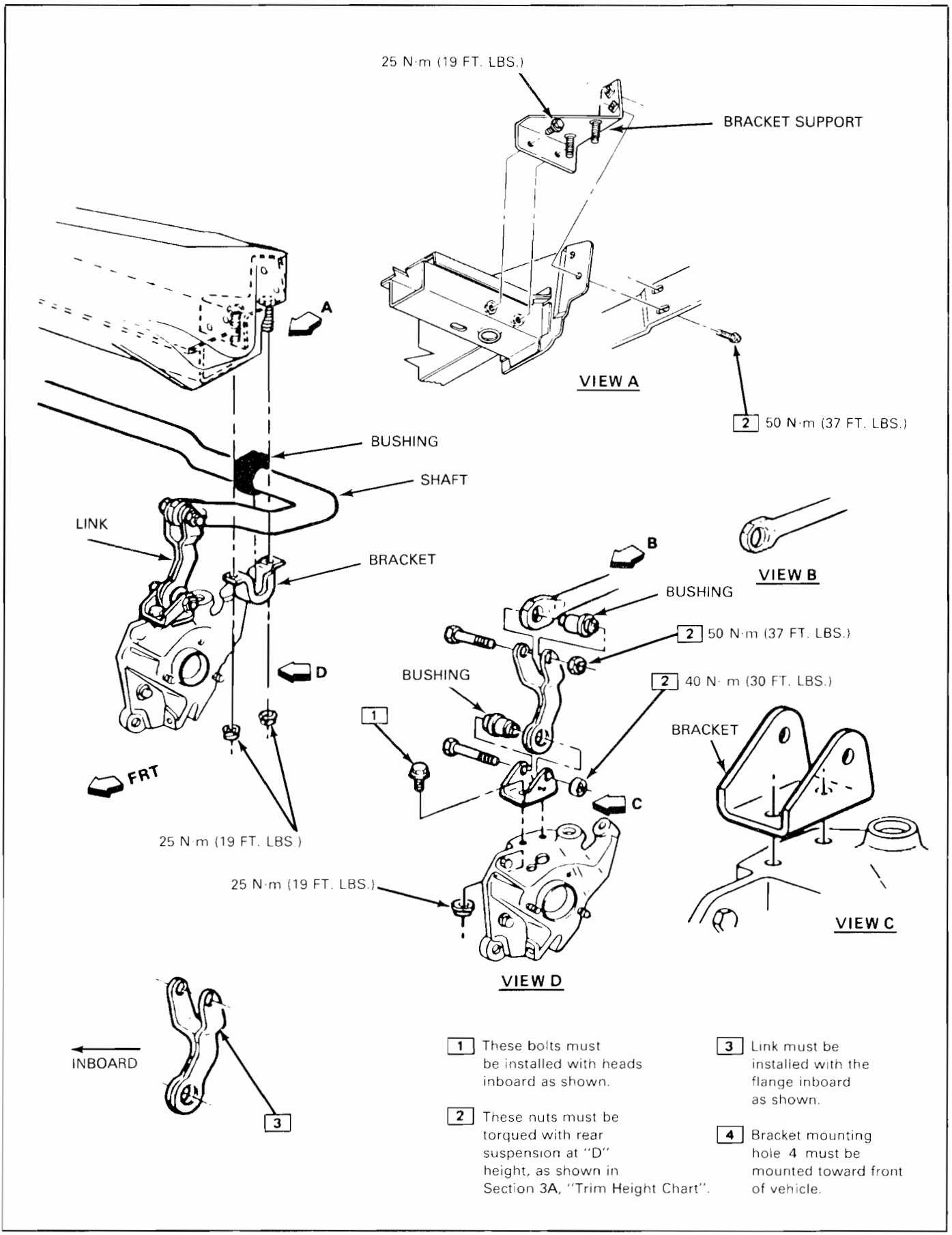


Figure 3D-7 Rear Stabilizer

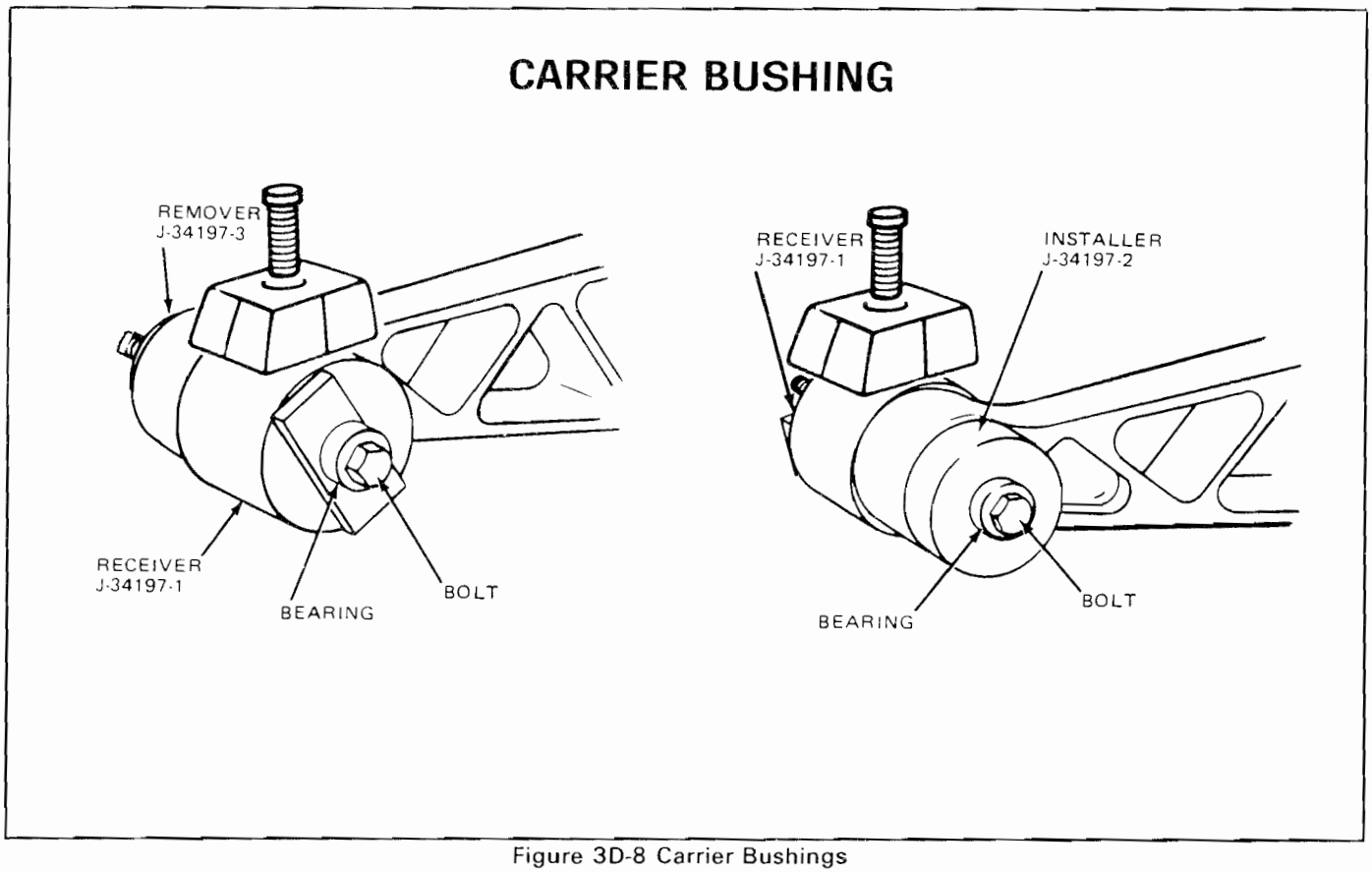


Figure 3D-8 Carrier Bushings

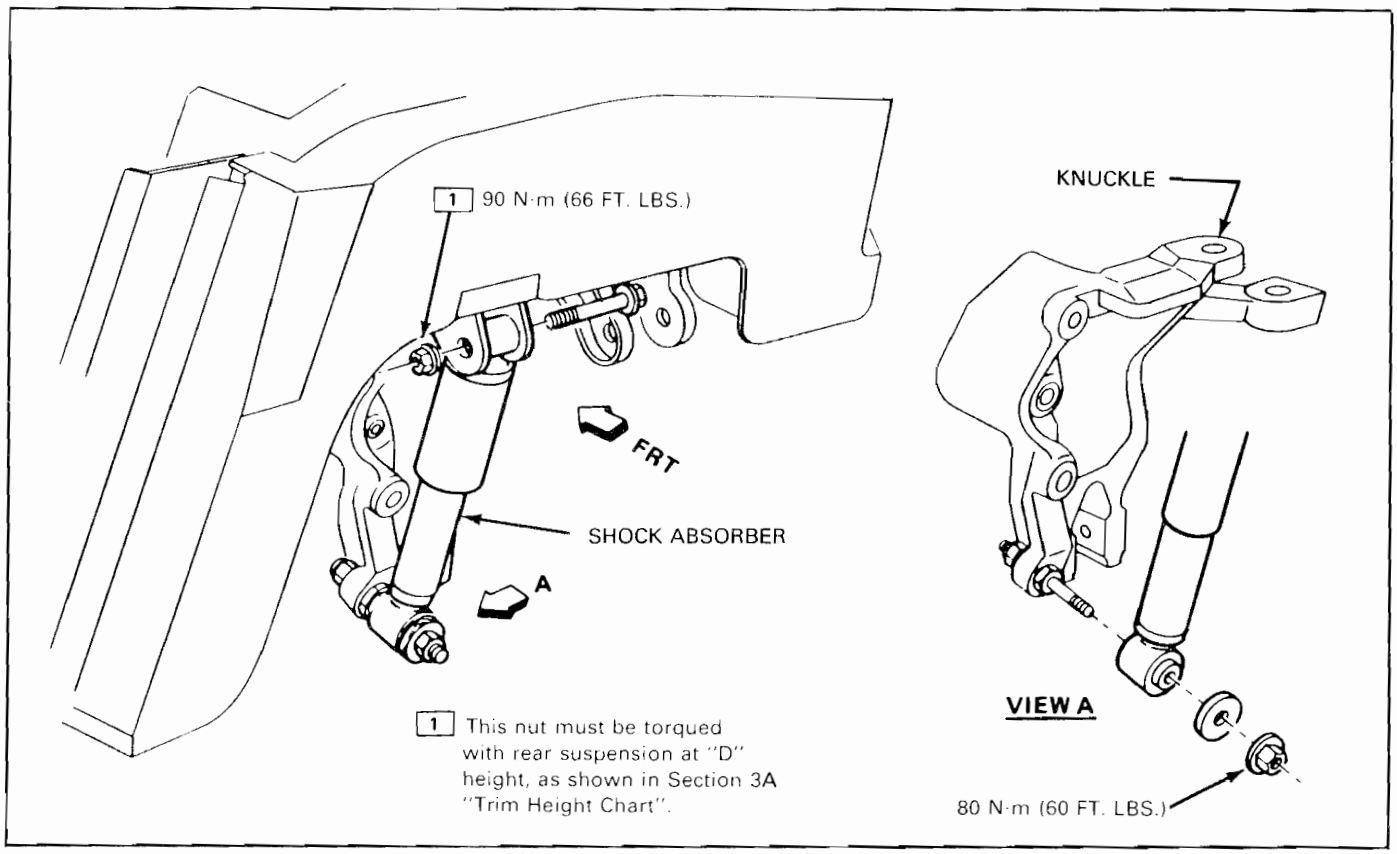
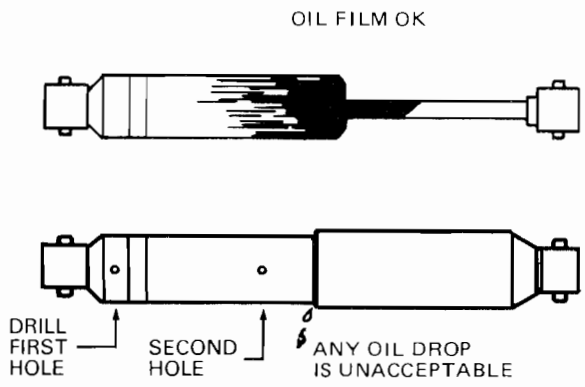


Figure 3D-9 Shock Absorbers

Gas Shock Absorbers

Leakage Diagnosis :

The appearance of oil film on the shock absorber body or piston rod is normal. Any dripping of oil is unacceptable.



Disposal:

Due to the high pressure of gas it is advised that, upon scrapping or disposal of these shock absorbers, the pressure be released. This is carried out as follows:

a. Clamp shock in vise with piston rod pointing down.
b. Measure approx. 10-15 mm (0.5 in.) from bottom of shock and drill an approx. 5 mm hole so the gas can escape.
c. Measure approx. 140-150 mm (5.5-6.0 in.) from first hole and drill an approx. 5 mm hole to facilitate drainage of oil.
d. Drain oil from shock and then dispose of shock.

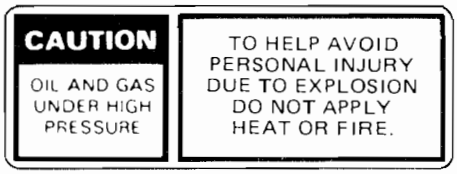


Figure 3D-10 Bilstein Gas Shock Absorbers

	N·m	FT. LBS.	
COVER BEAM TO BODY	135	100	
SUPPORT BEAM TO DIFF. CARRIER	80	60	
SUPPORT BEAM TO TRANSMISSION	70	52	
TRUNNION STRAPS AT SIDE GEAR YOKE	35	26	
TRUNNION STRAPS AT SPINDLE YOKE	35	26	
SPINDLE TO HUB AND BEARING	222	164	
HUB AND BEARING TO KNUCKLE	90	66	
DUST SHIELD TO BACKING PLATE	10	7	
SHOCK ABSORBER STUD TO KNUCKLE NUT	120	80	
SHOCK ABSORBER TO BODY	90	66	
SHOCK ABSORBER TO KNUCKLE	88	65	
CONTROL ARMS TO BODY	85	63	
CONTROL ARMS TO KNUCKLE	190	140	
JOUNCE BUMPER TO BODY	47	35	SNUG UP NUT, THEN ONLY NECESSARY TORQUE REQUIRED TO INSTALL COTTER PIN. DO NOT BACK OFF NUT.
TRANSVERSE SPRING LINK BOLT TO KNUCKLE			
TRANSVERSE SPRING TO COVER BEAM	50	37	
CAM BOLT TO SUPPORT ROD	252	186	
SUPPORT ROD TO KNUCKLE	145	107	
SUPPORT ROD BRACKET TO DIFF. CARRIER	75	55	
TIE ROD END TO KNUCKLE	45	33	
TIE ROD END LOCKING NUT	63	46	
TIE ROD HOUSING TO COVER BEAM	74	54	
STABILIZER BAR TO BODY	25	18	
STABILIZER LINK TO BRACKET AND BAR	52	38	
STABILIZER LINK BRACKET TO KNUCKLE	25	18	
UNDERBODY BRACE (MODEL 67) NUTS	25	18	
BOLTS	65	48	

Figure 3D-11 Torque Specifications

1. **CARRIER**, Diff
2. **ROD**, Rr Axle Tie
3. **BOLT**, Rr Axle Tie
4. **WASHER**
5. **NUT**, Rr Axle Tie Rod
6. **PIN**, Cot (M3.2x25)
7. **RETAINER**, Rr Spr Upr
8. **SPRING**, Rr
9. **RETAINER**, Rr Spr Lwr
10. **CUSHION**, Rr Spr
11. **INSULATOR**, Rr Spr
12. **SPACER**, Rr Spr
13. **PLATE**, Rr Spr Anc
14. **BOLT**, Hfh (M 10x1.5x100)
15. **BOLT**, Hfh (M10x1.5x30)
16. **SHAFT**, Dr Ujt
17. **BOLT**, Dr Ujt Shf Ret
18. **RETAINER**, Rr Whl Dr Ujt Shf
19. **SPINDLE**, Rr Whl
20. **BOLT**, Rr S Abs Upr
21. **ABSORBER**, Rr
22. **NUT**, Hex (M12x1.75)
23. **WASHER**, Rr S Abs
24. **STUD**, Rr S Abs
25. **WASHER**, Rr S Abs
26. **NUT**, Hex (M14x2)
27. **PIN**, Cot (M4x40)
28. **RETAINER**, Whl Nut
29. **NUT**, Spdl
30. **WASHER**, Spdl
31. **HUB**, Rr Whl
    BOLT, Rr Whl Mtg
32. **PLATE**, P Brk & Clpr Mtg
33. **WASHER**, Rr Whl Spdl
34. **SHIELD**, Rr Brk-LH
35. **BOLT**, Hex (M6.3x1.81x16)
36. **NUT**, Rr Spr
37. **INSULATOR**, Rr Spr
40. **BUSHING**, Spdl Rod
41. **CAM**, Spdl Rod Adj
42. **BOLT**, Rr Spr
43. **WASHER**
44. **BOLT**, Rr Whl Hub
45. **NUT**, Spdl Rod Adj
46. **NUT**, Hex (M10x1.5)
47. **BRACKET**, Spdl Rod
48. **BOLT**, Hex (M10x1.5x75)
49. **BOLT**, Rr Whl Spdl Rod Adj
50. **NUT**, Hex (M16x2)
51. **WASHER**, Spdl Rod
52. **ROD**, Spdl
53. **KNUCKLE**, Rr Susp
54. **BOLT**, Hex (M16x2x110)
55. **ROD**, Rr Whl Spdl Lwr Cont
56. **BRACKET**, Spdl Cont Rod
57. **BOLT**, Rr Whl Spdl Rod (M12x1.75x75)
58. **BOLT**, Hex (M12x1.75x50)
59. **ROD**, Rr Whl Spdl Upr Cont
60. **WASHER**, Spdl Rod to Knu
61. **BOLT**, Spdl Rod to Knu
62. **BUMPER**, Rr Susp
63. **BRACKET**, Rr Susp Bpr
64. **NUT**, Hex (M10x1.5)
65. **NUT**, Rr Stab Shf Lind
66. **BRACKET**, Rr Stab Shf
67. **LINK**, Rr Stab Shf
68. **INSULATOR**, Rr Stab Shf Link
69. **SHAFT**, Rr Stab
70. **BOLT**, Rr Stab Shf Link
71. **INSULATOR**, Rr Stab Shf
72. **SUPORT**, Rr Stab Shf Brkt
73. **BRACKET**, Rr Stab Shf
74. **NUT**, Hex Flg (M8x1.25)
75. **BOLT**, Diff Carr
76. **BRACKET**, Diff Carr
77. **BOLT**, Hex (M8x1.25x30)
78. **SEAL**, Rr Whl Hub Brg
79. **DAMPENER**, Dr Line Vib
80. **BOLT**, Vib Dpnr
81. **SOCKET**, Rr Axle Otr
82. **SUPPORT**, Driveline
83. **NUT**, Prev Torq Hex Self-lk (M14x2)
84. **BOLT**, Hex (M14x2x205)
85. **REPAIR KIT**, Prop Shaft Ujt
86. **RETAINER**, Prop Shf
87. **BOLT**, Prop Shf
88. **SHAFT**, Prop
89. **YOKE**, Slip
90. **BOLT**, Hex (M12x1.75x165)
91. **WASHER**, Driveline Supt Frt
92. **NUT**, Prev Torq Self-lk (M12x1.75)

Figure 3D-13 Parts List

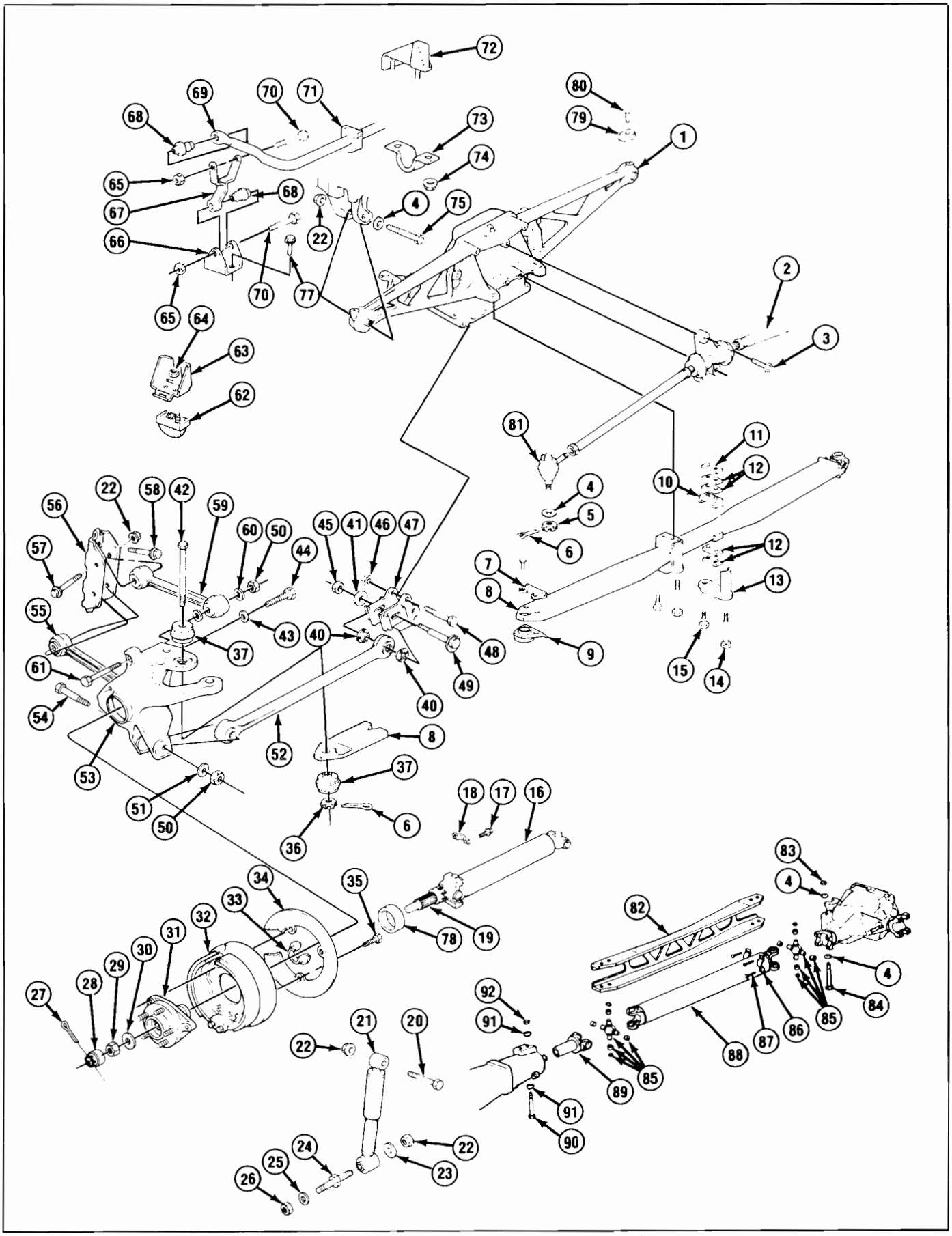


Figure 3D-12 Rear Suspension Parts Illustration

SECTION 3E

WHEELS AND TIRES

NOTICE The Wheel stud and nut fasteners are important attaching parts. They could affect the performance of vital components and systems, and/or result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of each part. There is to be NO heating, welding or hammering as this may result in extensive damage and weakening of the metal or wheel bearings.

NOTICE Extreme care must be taken when mounting and demounting tires on cars equipped with the optional (LTPWS) Low Tire Pressure Warning System.

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GENERAL DESCRIPTION

The factory installed tires and wheels are designed to operate satisfactory with loads up to and including the full rated load capacity when inflated to the recommended inflation pressures.

Correct tire pressures and driving techniques have an important influence on tire life. Heavy cornering, excessively rapid acceleration, and unnecessary sharp braking increase tire wear.

An optional Low Tire Pressure Warning System is available to continuously monitor the air pressure in each road tire (excluding the spare tire) while the vheicle is being driven. The Low Tire Pressure Warning System also includes a self-check feature that monitors the system's components. Should system failure or low pressure exist while the vehicle is being driven, the system will notify the driver through two amber warning lights on the instrument panel: the "LOW TIRE PRESSURE" lamp or the "SERVICE LTPWS" lamp.

Chevrolet's certified mechanics understand the need to maintain good customer satisfaction. The information contained in this section should be very helpful in providing optimum satisfaction!

REPLACEMENT TIRES

(Figure 3E-2)

A TPC (Tire Performance Criteria) specification number is molded in the sidewall near the tire size of all original equipment tires. See Figure 3E-2. This spec.

number assures that the tire meets GM's performance standards for traction, endurance, dimension, noise, handling, rolling resistance, and others. Usually, a specific TPC number is assigned to each tire size.

When replacing tires, only those with the same size, load range and construction as originally on the vehicle are recommended. This can best be accomplished by replacing with tires of the same TPC spec. number. Use of any other tire size or type may seriously affect ride, handling, speedometer/odometer calibration, vehicle ground clearance, and tire clearance to the body and chassis. The following should also be considered when replacing tires:

Chevrolet recommends a "VR" high performance tire be used. The speed rating on tires is required by law in Europe. The highest speed rating is a "V" for tires capable of sustained speeds above 130 mph.

CAUTION: Do not mix different types of tires such as radial, bias, and bias-belted tires because vehicle handling may be seriously affected and may result in loss of control.

Tires Should Be Replaced When:

- They are worn to a point where 1.6 millimeters (2/32 inch) or less tread remains, or the cord or fabric is showing. To help detect this, tires have built-in tread wear indicators that appear between the tread grooves when the tread is 1.6 millimeters (2/32 inch) or less. When the indicators appear in two or more adjacent grooves at three spots around the tire, the tire should be replaced.
- The tread or sidwall is cracked, cut or snagged deep enough to expose the cord or fabric.
- The tire has a bump, bulge or split. Slight sidewall indentations are normal and should not affect ride.
- The tire has a puncture, cut, or other damage that cannot be correctly repaired, because of the size or location of the damage.
- It is recommended that new tires be installed in pairs on the same axle. If necessary to replace only one tire, it should be paired with the tire having the most tread.

UNIFORM TIRE QUALITY GRADING

(Figure 3E-8)

The following information relates to the system developed by the United States National Highway Traffic Safety Administration which grades tires by traction and temperature performance. (This applies only to vehicles sold in the United States).

Traction - A, B, C

The traction grades, from highest to lowest are: A, B, and C. They represent the tire's ability to stop on wet pavement as measured under controlled conditions on specified government test surfaces of asphalt and concrete. A tire marked C may have poor traction performance.

NOTICE: The traction grade assigned to this tire is based on braking (straight-ahead) traction tests and does not include cornering (turning) traction.

Treadwear

The treadwear grade is a comparative rating based on the wear rate of the tire when tested under controlled conditions on a specified government test course. For example, a tire graded 150 would wear one and a half (1-1/2) times as well on the government course as a tire graded 100. The relative performance of tires depends upon the actual conditions of their use, however, and may depart significantly from the norm due to variations in driving habits, service practices and differences in road characteristics and climate.

Temperature - A, B, C

The temperature grades are A (the highest), B, and C, representing the tire's resistance to the generation of heat and its ability to dissipate heat when tested under controlled conditions on a specified indoor laboratory test wheel. Sustained high temperature can cause the material of the tire to degenerate and reduce tire life, and excessive temperature can lead to sudden tire failure. The grade C corresponds to a level of performance which all passenger car tires must meet under the Federal Motor Vehicle Safety Standard No. 109. Grades B and A represent higher levels of performance on the laboratory test wheel than the minimum required by law.

NOTICE: The temperature grade for each tire is established for a tire that is properly inflated and not overloaded. Excessive speed, underinflation, or excessive loading, either separately or in combination, can cause heat buildup and possible tire failure. Owners located in the sunbelt should be made aware of the temperature grading.

These grades are molded on the sidewalls of passenger car tires.

Metric Sized Tires

(Figure 3E-2)

All GM vehicles now use P-metric (Passenger) sized tires, they are available in two load ranges, standard load (26 psi) and extra load (35 psi). Most passenger car tires are standard load.

Most P-metric tire sizes do not have exact corresponding alpha-numeric tire sizes. For example, a P205/75R15 is not exactly equal in size and load carrying capacity to an FR78-15. For this reason, replacement tires should be of the same TPC spec. number (same size, load range, construction) as those orignially on the vehicle. If P-metric tires must be replaced with other sizes, a tire dealer should be consulted. Tire companies can best recommend the closest match of alpha-mumeric to P-metric sizes within their own tire lines.

REPLACEMENT WHEELS

Wheels must be replaced if they are bent, dented, have excessive lateral or radial runout, have elongated bolt holes, or lug nuts will not stay tight. Wheels with greater runout than shown in Figure 3E-4 may cause objectional vibrations.

NOTE: If vehicle is equipped with the Low Tire Pressure Warning System, the sensors, which are mounted on each road wheel, must be transferred to the new wheel, and each wheel reinstalled to it's original position.

Sixteen-inch (16″) cast aluminum alloy wheels are standard. Wheel construction is right or left, as determined by cooling fin design. Front and rear wheels are 16 x 8-1/2″.

The Z51 option has 16 x 9-1/2″ wheels. The base 16 x 8-1/2″ wheels give clearance for compact snow chains, the optional 16 x 9-1/2″ wheels cannot be used with snow chains.

Replacement wheels must be equivalent to the original equipment wheels in load capacity, diameter, rim width, offset, and mounting configuration. A wheel of incorrect size or type may affect wheel and bearing life, brake cooling, speedometer/odometer calibration, vehicle ground clearance and tire clearance to the body and chassis.

Steel wheels (spare) can be identified by a two or three-letter code stamped into the front side rim near the valve stem. Aluminum wheels have the code, part number, and manufacturer's ID cast into the backside.

NOTICE: The use of aftermarket reverse-type wheels, designed to move the wheel away from the body, will increase the scrub radius. An increased scrub radius may greatly increase steering effort and reduce wheel bearing life.

HUB CAPS

The aluminum wheels on your Corvette have center hub caps. Their removal should not be necessary unless the tire has to be dismounted from the wheel. To remove the caps, tap from the backside using a wooden hammer handle to pop off the caps. To install, place cap into position at wheel opening and strike squarely with rubber mallet.

Wheel Nuts

Remove the black plastic wheel nut cap using wheel nut wrench and then remove wheel nut using the same wrench.

LOCKING WHEEL NUTS

(Figure 3E-18)

Each wheel has one locking nut which requires a special tool (key) for removal. This key is stored with the wheel wrench in the right rear storage compartment. The owner may want to move the location of the special tool (key).

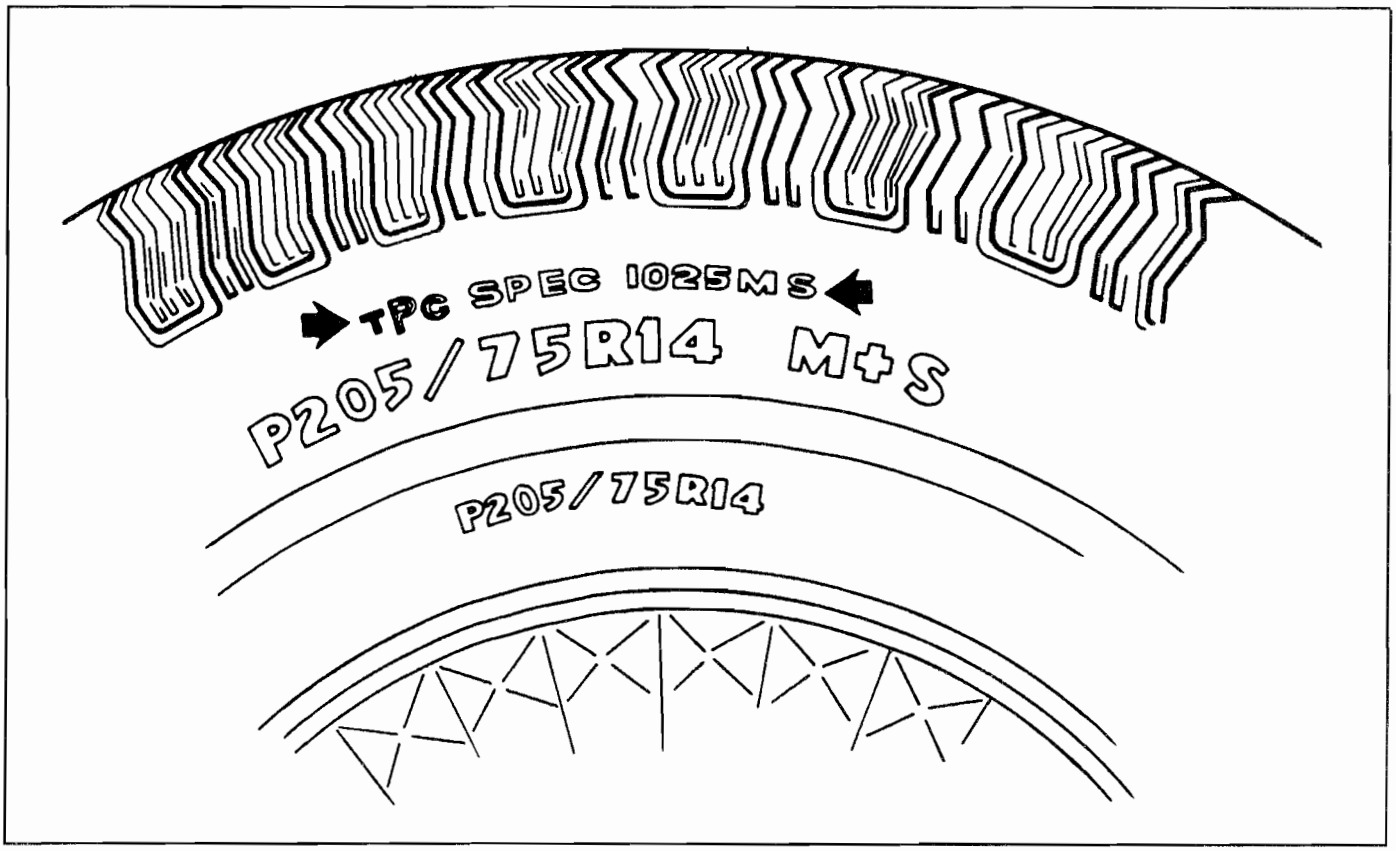


Figure 3E-1 TPC Specifications

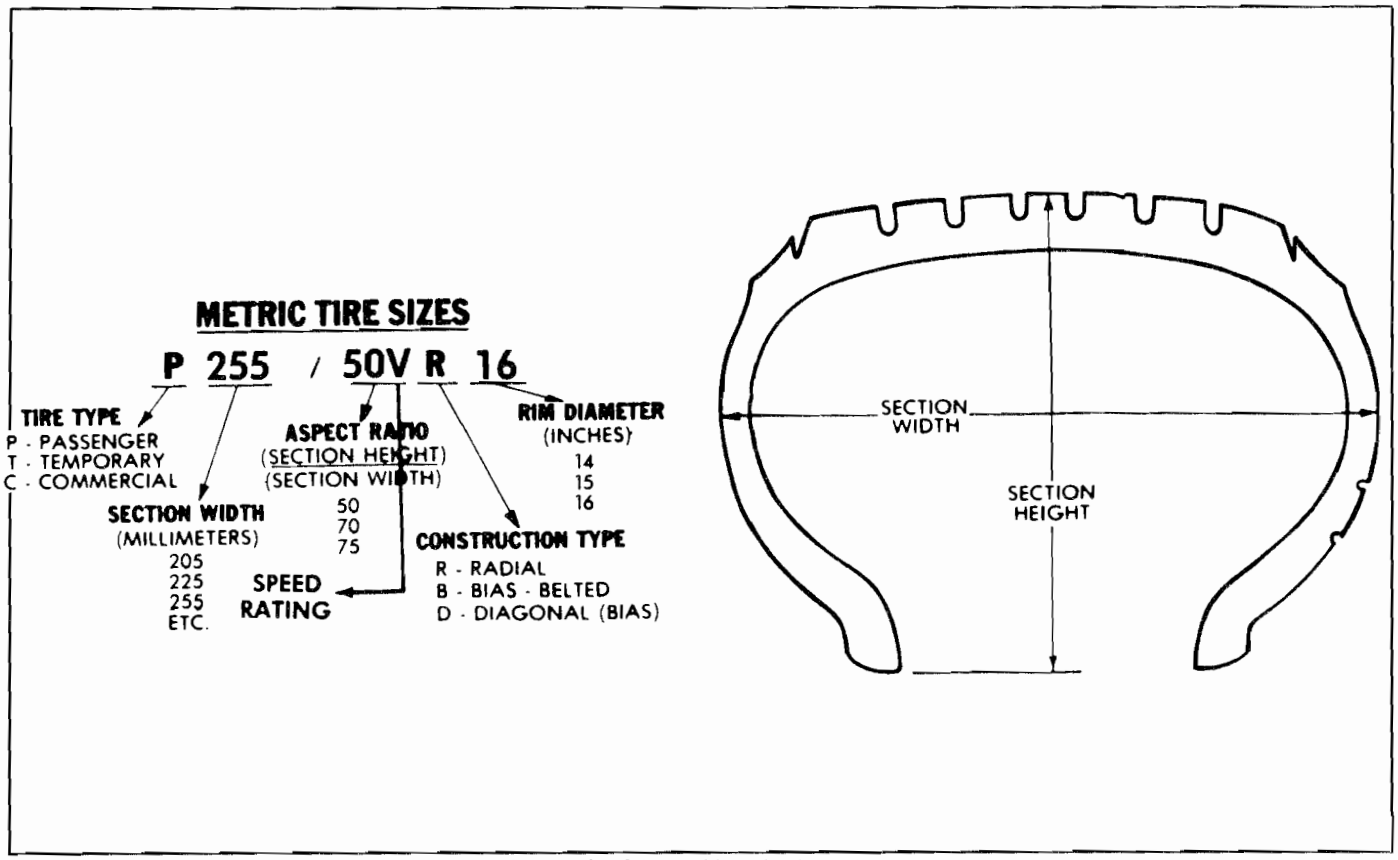


Figure 3E-2 Tire Size Explanation

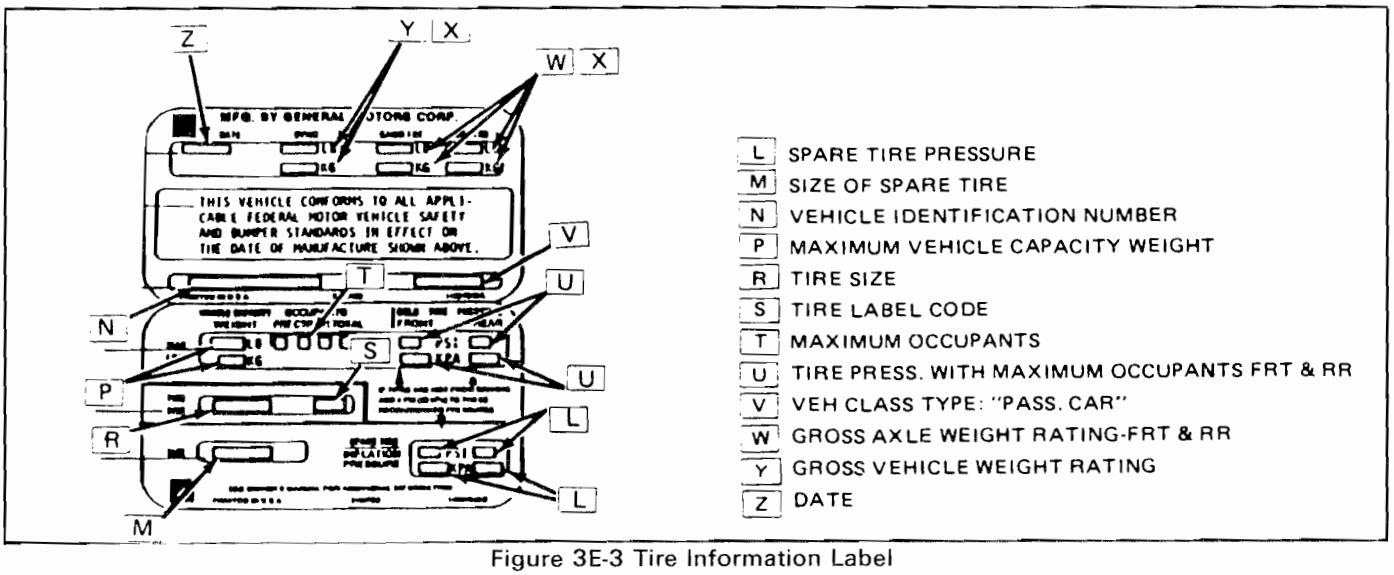


Figure 3E-3 Tire Information Label

Remove Locking Wheel Nut As Follows:

1. Remove the black plastic wheel nut cap using the wheel nut wrench.
2. Thread the outer cylinder of the wheel lock key clockwise onto the locking nut. Hand-tighten the key until it stops (about one turn).
3. Back off (turn counter-clockwise) the outer cylinder about 1/4 turn until the inner hex nut of the key can be turned.
4. Push in and turn the inner hex nut until it locks into the locking wheel nut. Re-tighten the outer cylinder hand tight.

TIRE INFORMATION LABEL

(Figure 3E-3)

The tire information label is permanently located on the rear of the driver's door edge, and should be referred to for tire information. The label lists the maximum vehicle load, tire size (including spare), and cold inflation pressure (including spare). See example in Figure 3E-4.

The metric equivalent of inflation pressure is kilopascal (kPa) Tire pressure will usually be printed in both kPa and pounds per square inch (psi). Metric tire gages are available from tool suppliers.

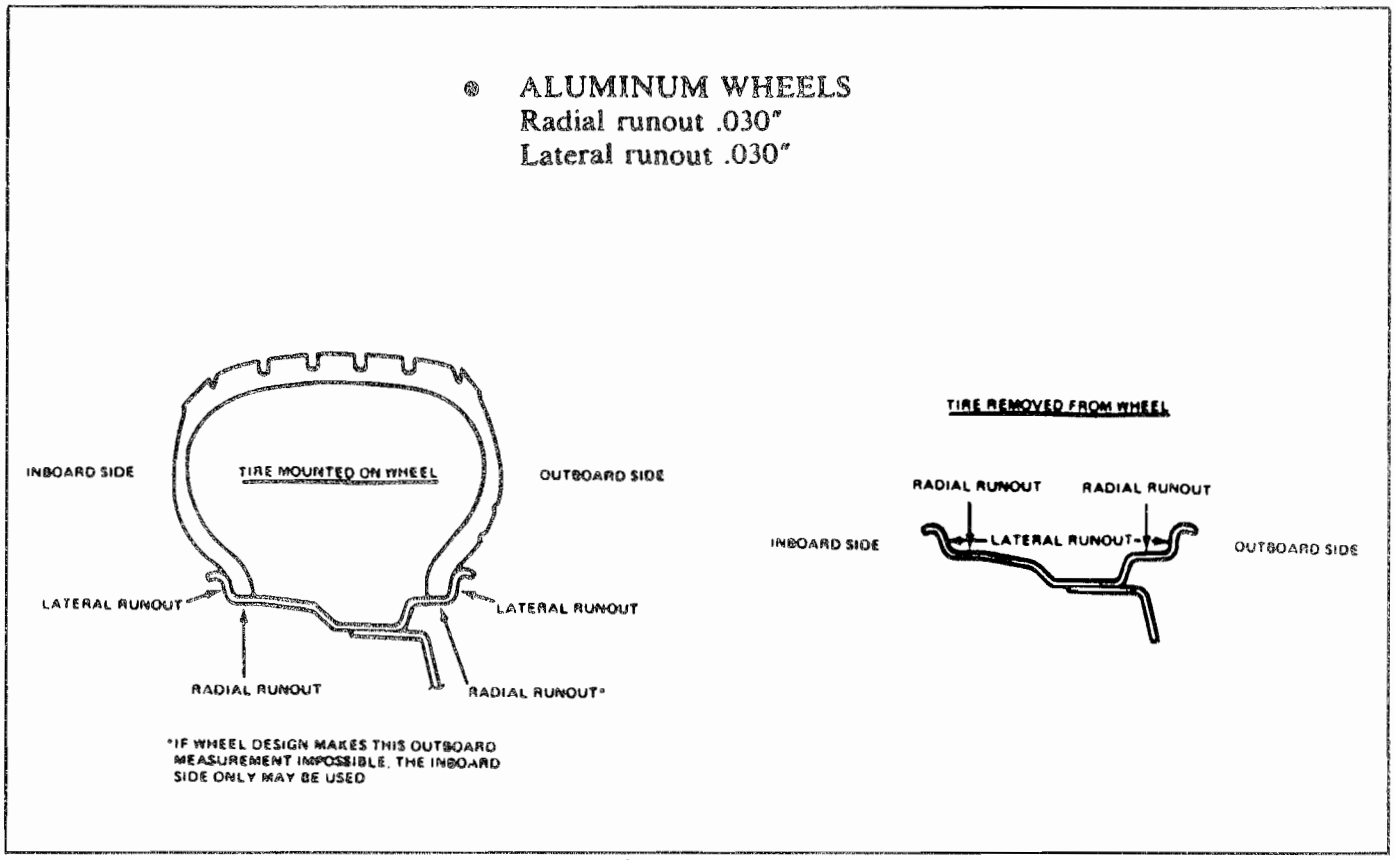


Figure 3E-4 Wheel Runout

MAINTENANCE AND MINOR ADJUSTMENTS

WHEEL ATTACHING STUDS AND NUTS

(Figures 3E-5 and 35-6)

Metric nuts and wheel studs are identified as follows: The nut has the word "Metric" stamped on its face and the STUD has the letter "M" stamped into the end of the stud. The word "Metric" is stamped on the head of the STUD also.

The thread size of metric wheel nuts and studs are indicated by the following example: "M12 x 1.5"

M = Metric

12 = Dia. in millimeters

1.5 = millimeters per thread (gap between)

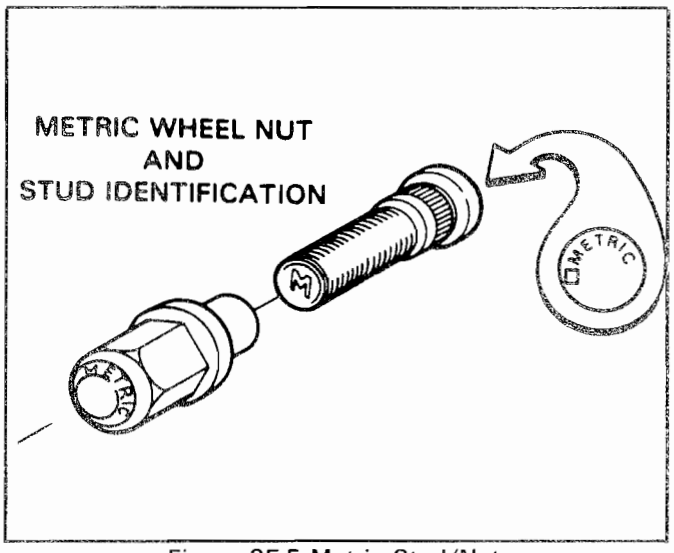


Figure 3E-5 Metric Stud/Nut

INFLATION OF TIRES

The pressure recommended for all models is carefully calculated to give a comfortable ride, responsive steering, maximum tread wear, tire life and resistance to bruises.

Tire pressure, with tires cold, (after vehicle has set for three hours or more, or driven less than one mile) should be checked monthly or before any extended trip and set to the specifications on the tire label located on rear face of driver's door.

Valve caps or extensions should be on the valves to keep dust and water out.

Tire pressure may be printed in both kPa and psi. One (1) psi equals 6.9 kPa.

Higher than recommended pressure can cause:

- Hard ride.
- Tire bruising or carcass damage.
- Rapid tread wear at center of tire.

Lower than recommended pressure can cause:

- Tire squeal on turns
- The Low Tire Pressure Warning System may illuminate the telltale lamp.

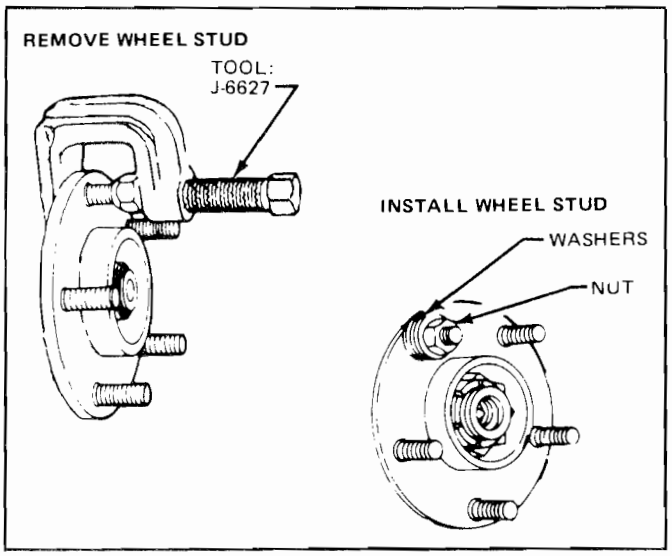


Figure 3E-6 Wheel Stud Replacement

- Hard Steering
- Rapid and uneven wear on the edge of the tread
- Tire rim bruises and rupture
- Tire cord breakage
- High tire temperatures
- Reduced handling
- High fuel consumption

Unequal pressure on same axle can cause:

- Uneven braking
- Steering lead
- Reduced handling
- Swerve on acceleration

TIRE ROTATION

(Figure 3E-7)

To equalize wear, rotate tires at 7,500 miles and again every 15,000 miles thereafter. Whenever uneven tire wear is noticed, the cause should be investigated. In Figure 3E-7, this is the only method of rotation recommended for the Corvette.

Due to their design, radial tires tend to wear faster in the shoulder area particularly in front positions. Radial tires in non-drive locations, may develop an irregular wear pattern that can generate tire noise. This makes regular rotation especially necessary.

Always use 4-wheel rotation. After rotation, be sure to check wheel nut torque and set tire pressure. Never use oil or grease on studs or nuts. See "Wheel Nut Torque" in this section.

TIRE CHAIN USAGE

(Figure 3E-9)

Due to limited tire-to-body clearance, we recommend SAE Class "S" tire chains. They may also be designated as 1100 Series, Type PL tire chains. The chains are designed to limit the "fly off" effect that occurs when the wheel rotates. Figure 3E-6 shows three different designs, including the "S" design.

Manufacturers of tire chains have a specific chain size for each tire size to ensure proper fit when installed. Therefore, be sure to purchase the correct chains for the tires on which they are to be used. Rubber adjusters should not be used to take up slack or clearance in chains which are loose due to incorrect size. Always follow the chain manufacturers installation instructions and speed restrictions.

Driving With Chains

When chains are used, the vehicle handling may be adversely affected. Make note of the following:

- Install the chains to the drive tires as tightly as possible, then tighten them again after driving 1/4 to 1/2 mile.
- Check, and do not exceed manufacturer's recommended maximum safe speed.
- Adjust speed to road conditions.
- Drive cautiously, avoid bumps, potholes, shart turns and other manueuvers which may cause the vehicle body to contact the chains.

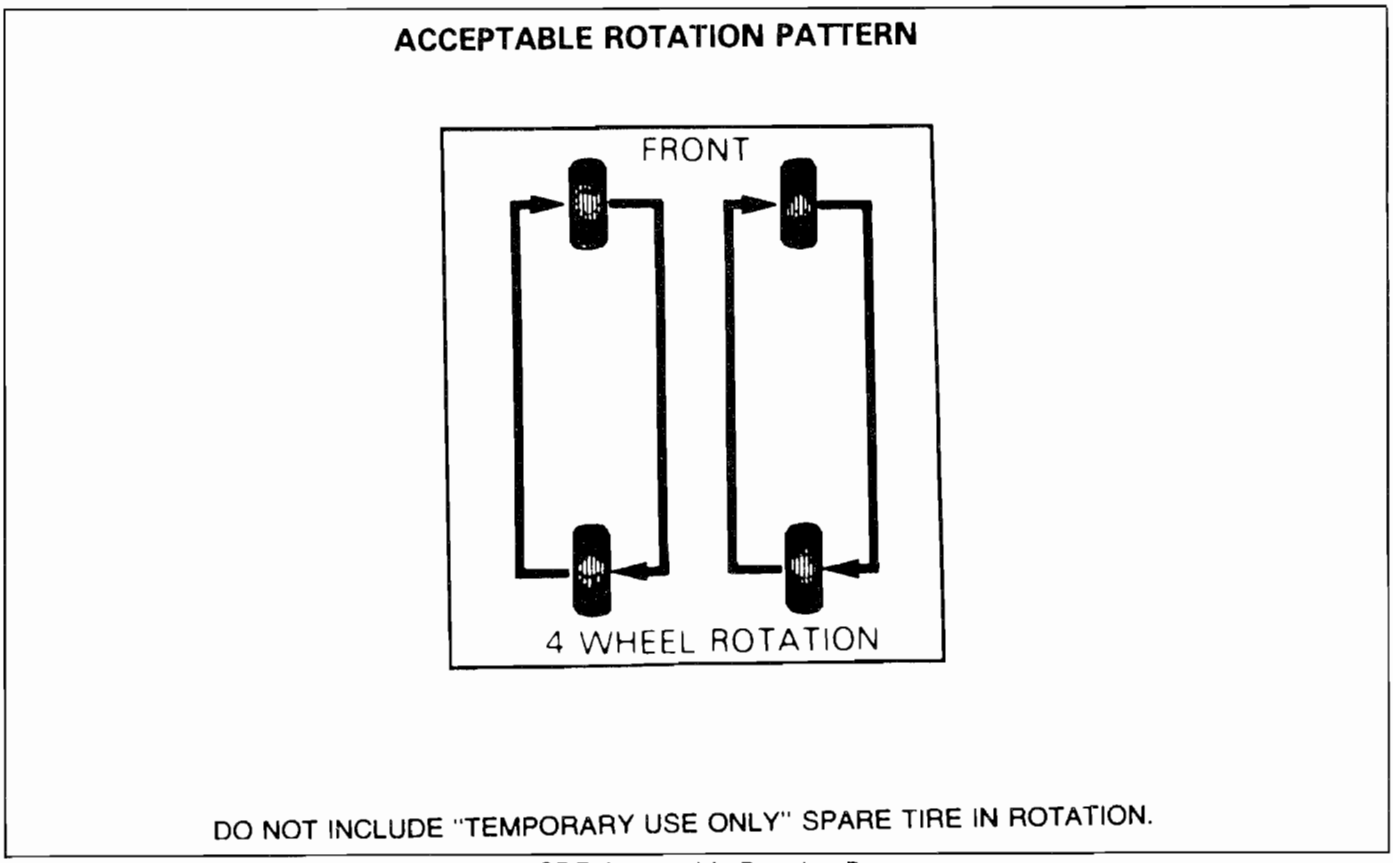


Figure 3E-7 Acceptable Rotation Pattern

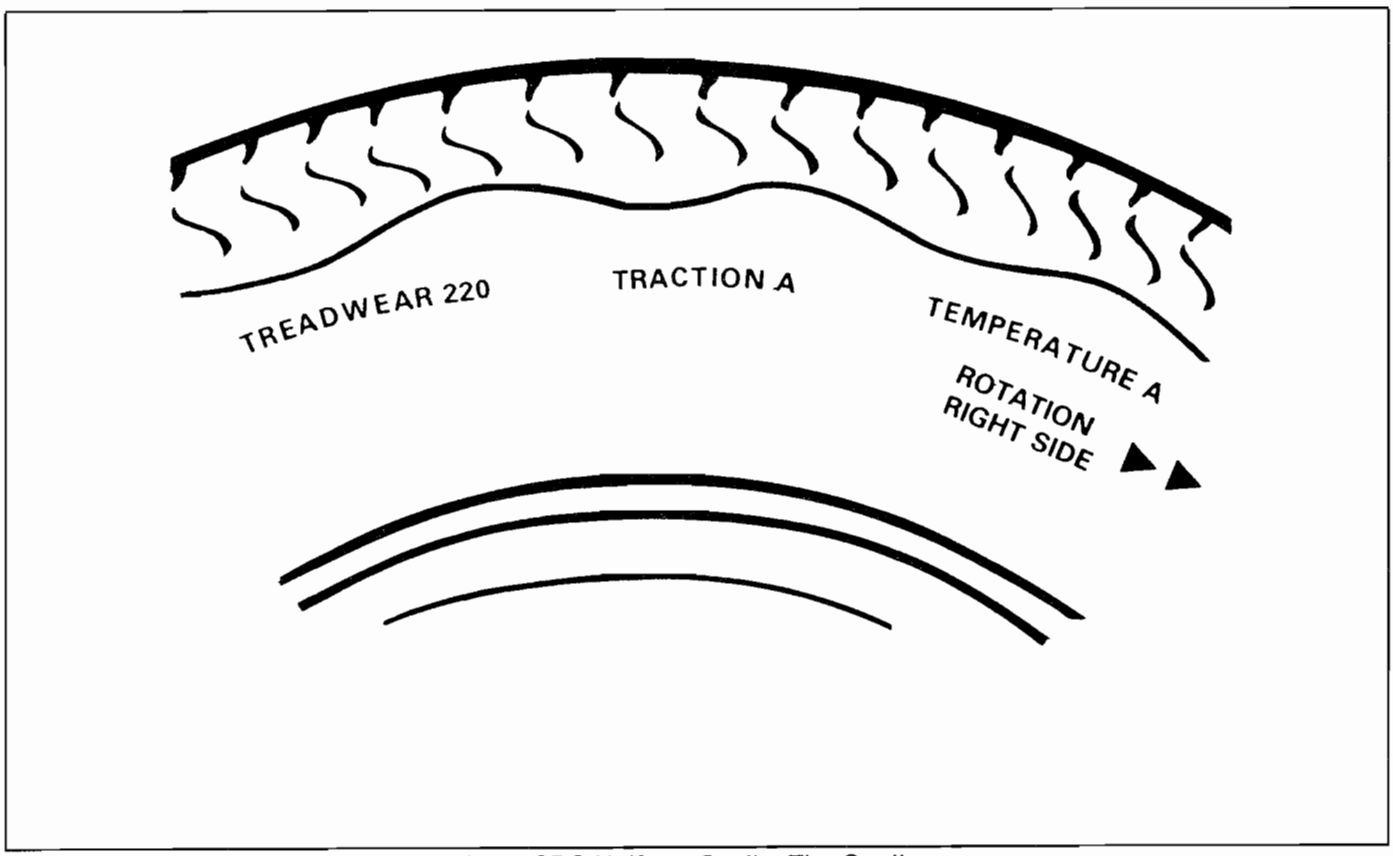


Figure 3E-8 Uniform Quality Tire Grading

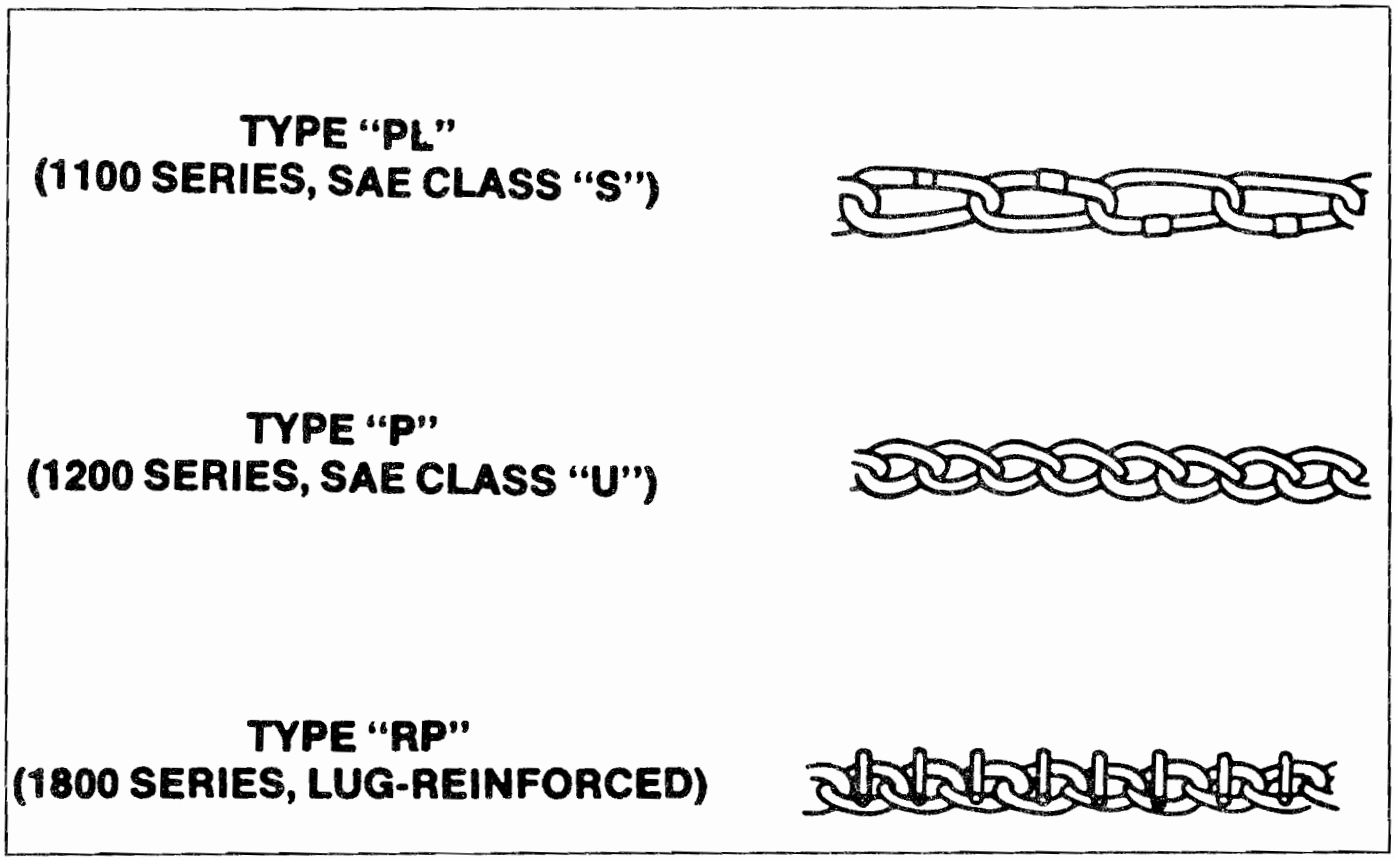


Figure 3E-9 Examples of Passenger Car Tire Chains

SERVICE OPERATIONS

WHEEL REMOVAL

Sometimes wheels can be difficult to remove due to foreign material or a tight fit between the wheel centerhole and the axle hub, drum or rotor. Excessive force such as hammering the wheel or tire can cause damage and is not recommended. Slight tapping on the tire sidewall, such as with one's hand or foot or the use of a large rubber mallet is acceptable. The wheel can be removed without damage as follows:

1. Retighten all wheel nuts on the affected wheel, then loosen each nut two turns. Rock the vehicle side to side. If this is not effective go to Step 2.
2. Rock the vehicle from "drive" to "reverse" allowing the vehicle to move several feet in each direction. Apply quick, hard jabs on the BRAKE pedal to loosen the wheel. If that did not free up the wheel, then rock the vehicle again, from side to side as hard as possible using one or more persons' body weight to loosen the wheel. If the wheel is still tight, repeat the procedure.
3. Raise the vehicle. Remove the wheel nuts and the wheel.

Pentrating oil has not been found to be effective in removing tight wheels. However, if it is used it should be applied sparingly to the hub surface only.

CAUTION: Do not allow the penetrating oil to get on the vertical surfaces between the wheel and the drum (or rotor) because penetrating oil in this area could cause the wheel to work loose as the vehicle is driven causing loss of control. Never use heat to loosen a tight wheel, it can shorten the life of the wheel, studs or wheel bearings.

Wheel nuts must be tightened in sequence (See Figure 3E-11)and to the proper torque to avoid bending the wheel, brake drum or rotor.

CAUTION: Before installing a wheel, remove any build up of corrosion on the wheel mounting surface, brake drum or disc mounting surface by scraping and wire brushing. Installing wheels without good metal-to-metal contact at the mounting surfaces can cause wheel nuts to loosen, which may later, allow the wheel to come off while the vehicle is in motion.

TIRE MOUNTING AND DEMOUNTING

(See Figure 3E-10)

NOTICE: Extreme care must be taken when mounting and demounting tires on cars equipped with the optional (LTPWS) Low Tire Pressure Warning System.

Mounting/Dismounting Tires With LTPWS

Care must be taken when mounting or dismounting tires on cars equipped with the optional

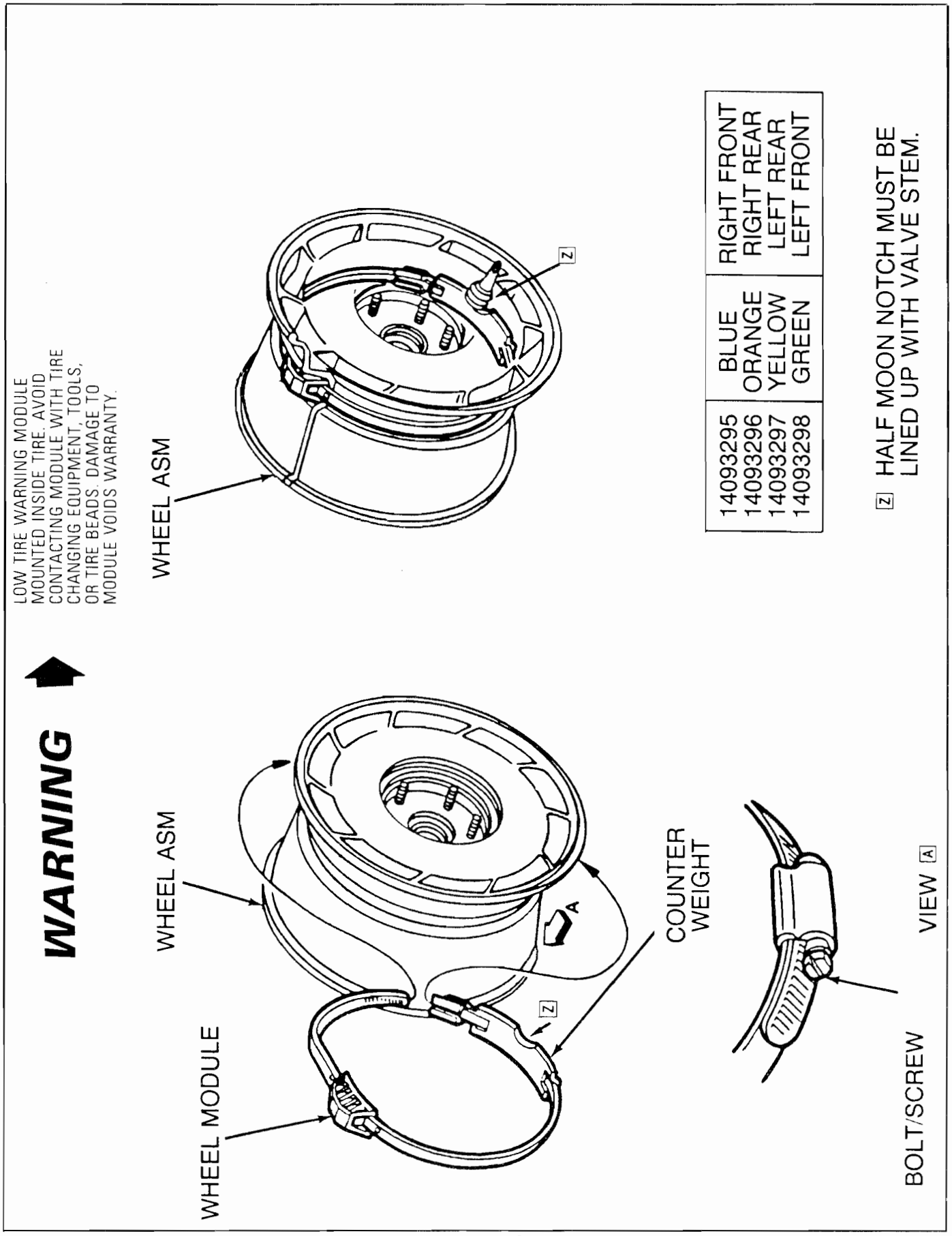


Figure 3E-10 LTPWS Sensor

low tire warning system (LTPWS). Each wheel has a module strapped around the wheel, inside the tires, as shown in Figure 3E-10. This module will always be located directly opposite the valve stem (180°). Position the tire and wheel on the changing machine so that the upper/lower bead breaker or other tire change tools will not contact the wheel module during tire mounting or dismounting. Many tire changing machines have upper and lower bead breakers located 180°) apart that operate simulatenously. On such machines, the valve stem should be located midway between the two bead breakers so that the wheel module is at least 90°) away from either bead breaker. A color coded decal on the wheel should aid in properly positioning the tire and wheel on the tire changing machine. Your failure to do this can break the wheel module and void the warranty.

Mounting/Dismounting Tires Without LTPWS

Use a tire changing machine to mount or demount tires. Follow the equipment manufacturer's instructions. Do not use hand tools or tire irons alone to change a tire as they may damage the tire beads or wheel rim. See "Matched Tires and Wheels."

Rim bead seats should be cleaned with a wire brush or coarse steel wool to remove old rubber, and light rust or corrosion. Before mounting or demounting a tire, the bead area should be cleaned and well lubricated with GM No. 1051717 (50% lubricant and 50% water) or equivalent.

CAUTION: Do not lubricate the tire beads or wheel rim with lubrication containing "silicone".

After mounting, inflate to 275 kPa (40 psi) so that beads are completely seated.

CAUTION: Do not stand over the tire when inflating. The bead may break when it snaps over safety hump and cause serious personal injury.

CAUTION: Do not exceed 275 kPa (40 psi) pressure when inflating. If 275 kPa (40 psi) pressure will not seat beads, deflate, re-lubricate and inflate.

CAUTION: Overinflation may cause the bead to break and cause serious personal injury.

Install the valve core and inflate to the pressure specified on the **Tire Information Label** on the rear of the driver's door. Check the locating rings of the tire to be sure they show around the rim flanges on both sides. See Figure 3E-12.

WHEEL REPAIR

Wheel repairs that use welding, heating, or peening are not approved. An inner tube is not an acceptable repair for leaky wheels or tires.

Cast Aluminum Wheel Porosity Repair

1. Remove wheel and tire assembly from vehicle.
2. Locate leaking areas by inflating tire to 40 PSI and dipping into water bath.
3. Mark leak areas as well as scribe the tire/wheel at valve core, then remove tire from wheel.
4. Scuff inside rim surface at leak area with 80 grit paper and clean area with general purpose cleaner such as 3M #08984 or equivalent.
5. Apply 1/8" thick layer of adhesive/sealant P/N 1052366 or equivalent to leak area and allow twelve hours of drying time.
6. Mount tire on wheel, align the scribe mark with valve core, pressurize to 40 PSI and check for leaks.
7. Adjust tire pressure to meet specifications on driver's door.
8. Balance wheel and tire assembly.
9. Reinstall wheel-tire assembly on vehicle.
10. Torque wheel nuts.

TIRE REPAIR

There are many different materials and techniques on the market to repair tires. Not all work on some types of tires. Tire manufacturers have published detailed instructions on how and when to repair tires. The instructions can be obtained from the tire manufacturer.

TEMPORARY - COMPACT SPARE

(Figure 3E-13)

The Corvette is equipped with a high pressure compact spare. The compact spare uses a steel 16x4 inch wheel and a T155/80D16 spare tire.

NOTE: When this vehicle is equipped with the Low Tire Pressure Warning System, and the temporary spare is used, the "SERVICE LTPWS LAMP will be illuminated until the road wheel with the sensor is replaced.

Standard tires or snow tires must not be used on a compact spare wheel. If they are used, damage to vehicle may occur.

Inflation pressure of the compact spare must be periodically checked and maintained at 415 kPa (60 psi). It can be mounted and dismounted from its wheel using present tire changing equipment and procedures. As with other tires, the beads should completely seat at 275 kPa (40 psi).

CAUTION: Do not exceed 275 kPa (40 psi) pressure when initially inflating any tire, including compact spares. If 275 kPa (40 psi) pressure will not seat beads, deflate, relubricate and inflate. Overinflation may cause bead to break and cause serious personal injury.

The temporary spare tire is designed to weigh less than your standard tires, and is easier to handle when need arises.

Check inflation pressure as soon as practical after installing spare and adjust to 60 psi.

COMPACT SPARE MAINTENANCE

It is recommended that repair or replacement of the compact spare tire be made only by an authorized tire dealer.

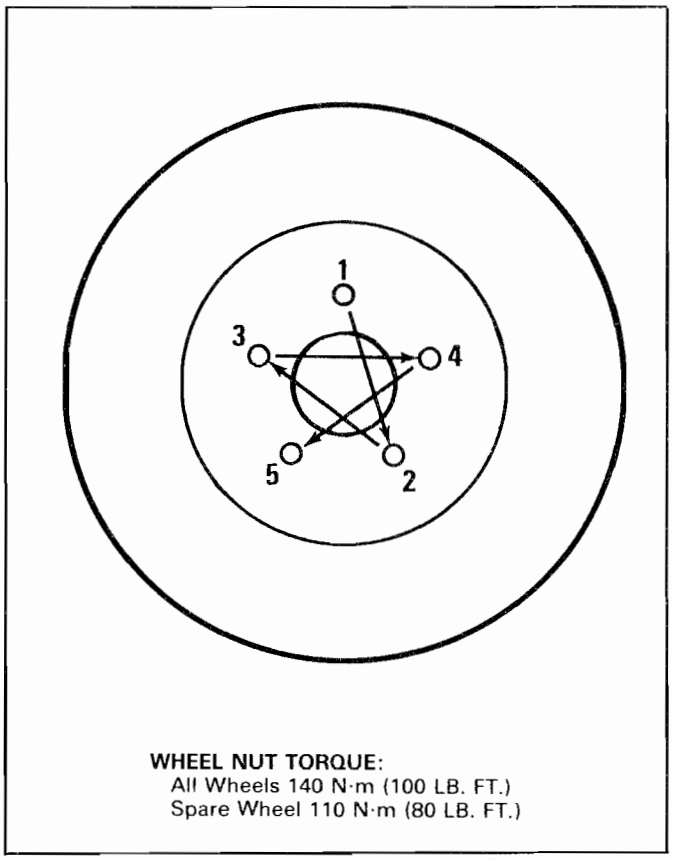


Figure 3E-11 Wheel Nut Tightening Sequence

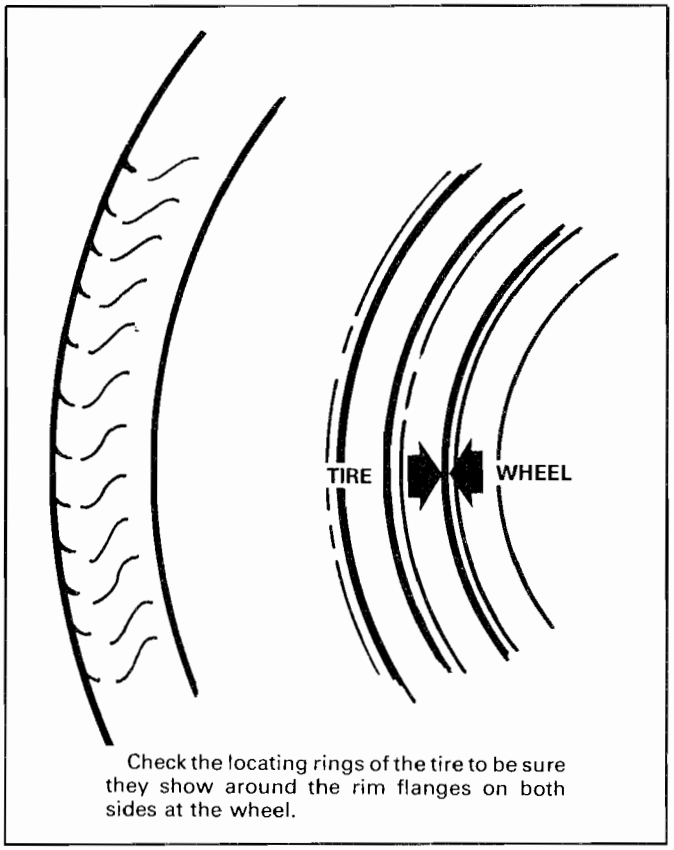


Figure 3E-12 Tire Locating Rings

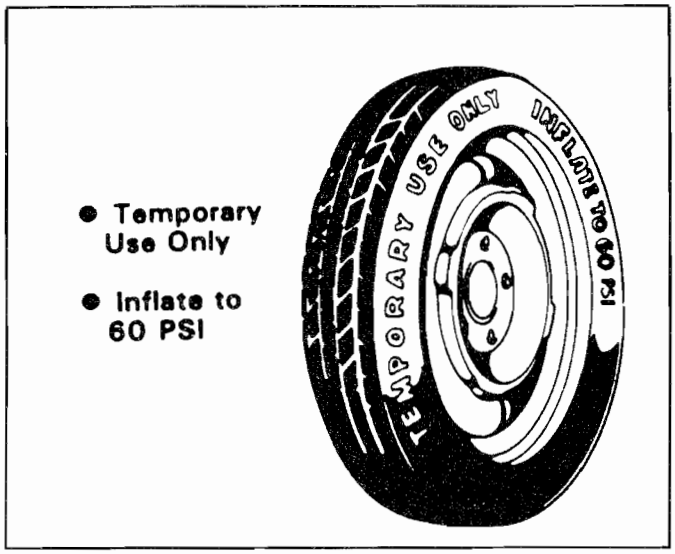


Figure 3E-13 Compact Spare

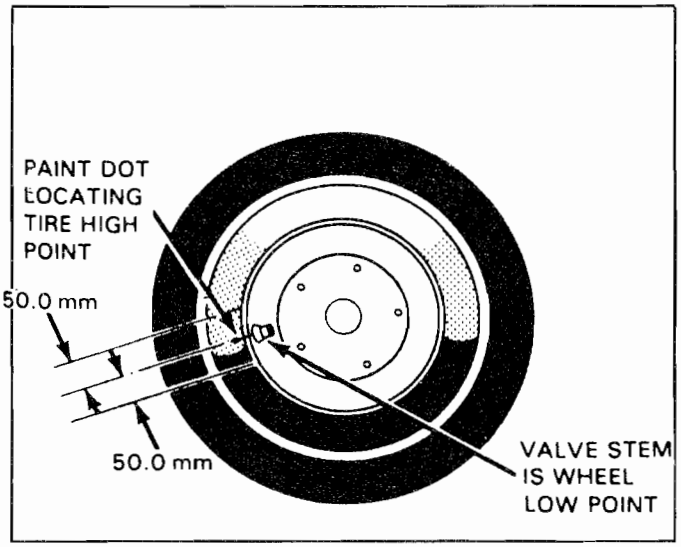


Figure 3E-14 Matched Tire To Wheel

MATCHED TIRES AND WHEELS

(Figure 3E-14)

Tires and wheels are matchmounted at the assembly plant. This means that the radially stiffest part of the tire, or "high spot", is matched to the smallest radius or "low spot" of the wheel. This is done to provide the smoothest possible ride.

The "high spot" of the tire is originally marked by a paint dot or adhesive sticker label on the outboard sidewall. This paint dot or sticker will eventually come off of the tire.

The "low spot" of the wheel is the valve stem hole.

Whenever a tire is dismounted from its wheel, it should be remounted so that the tire and wheel markings are matched. If the marks cannot be located, a crayon should be used to mark the tire at the valve before dismounting to assure that it is remounted in the original position. Replacement tires and wheels that are of original equipment quality will be marked in the same manner.

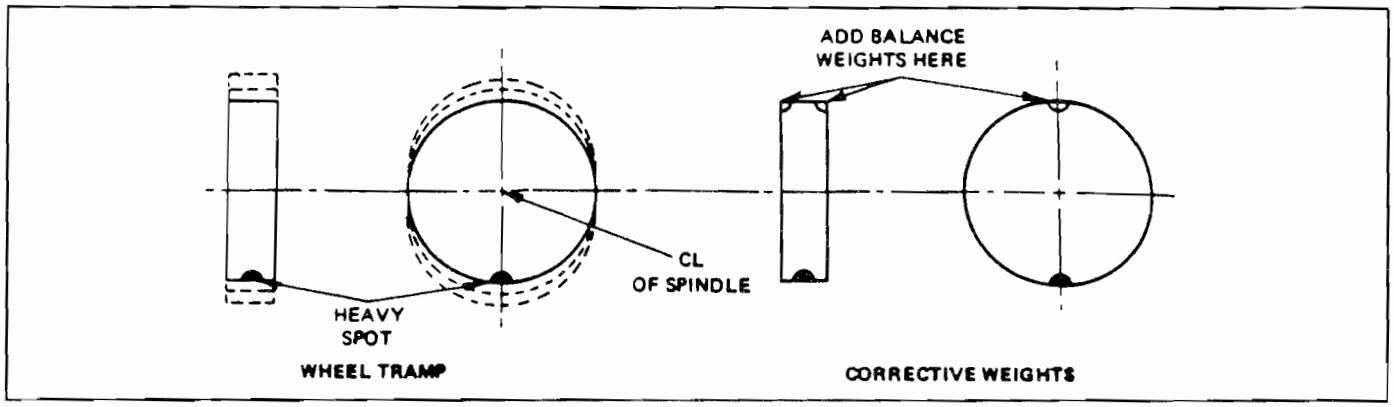


Figure 3E-15 Static Unbalance

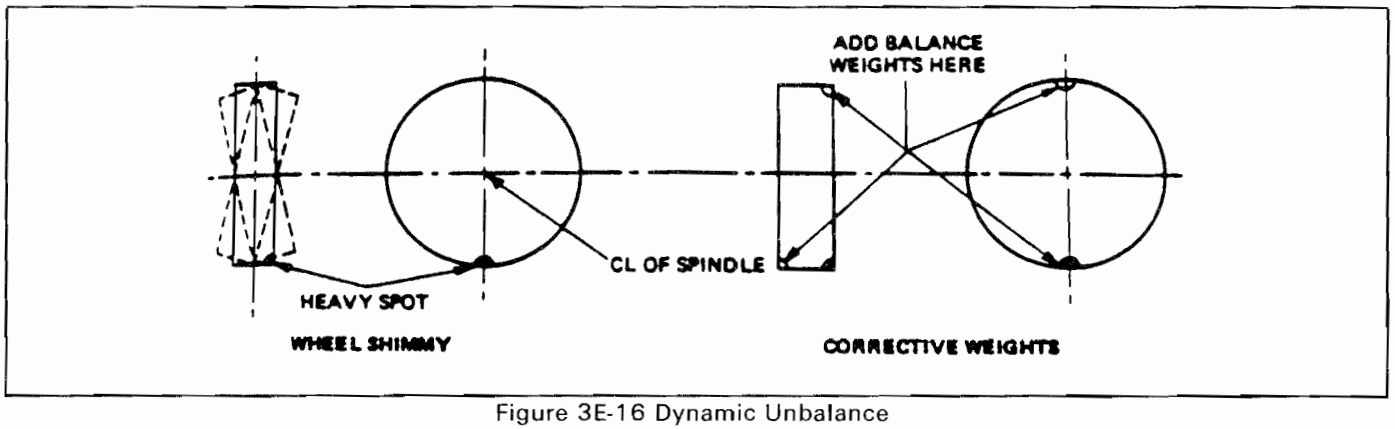


Figure 3E-16 Dynamic Unbalance

BALANCING TIRES AND WHEELS

(Figures 3E-15 and 3E-16)

All Corvettes are receiving a dynamic wheel balance at the Bowling Green assembly plant. This was done to improve Customer Satisfaction by providing the best possible balance for the smoothest possible ride.

With this dynamic balance, the Corvette becomes the first car to use new high-tech nylon coated clip-on wheel weights. These weights provide a much better appearance, and are used on both the outboard and inboard rim flanges. They will not discolor, corrode, or damage the wheel as may have been the case in the past with uncoated clip-on weights used on aluminum wheels.

These nylon-coated weights will fit most GM cast aluminum wheels. They are available in 1/4 ounce increments ranging from 1/4 ounce to 3 ounces, P/N 9591358 through 9591367 inclusively.

When installing the coated weights, care must be taken so that the nylon coating does not crack. It is recommended that a teflon coated hammer be used.

There are two methods by which tires and wheels are balanced: static and/or dynamic. Static balance is the equal distribution of weight around the wheel. Wheels that are statically unbalanced cause a bouncing action called shake.

Dynamic balance is the equal distribution of weight on each side of the certerline so that when the tire spins there is no tendency for the assembly to move from side to side. Wheels that are dynamically unbalanced may cause shimmy.

General Balance Precautions

CAUTION: WE RECOMMEND EYE PROTECTION BE USED.

Deposits of mud, etc. must be cleaned from the inside of the rim. Stones should be removed from the tread in order to avoid operator injury during spin balancing and to obtain a good balance. The tire should be inspected for any damage, then balanced according to the equipment maufacturer's recommendation.

Whenever a heavier, solid locking nut is used, it should be installed as close to the valve stem as possible. A 1/2 ounce balance weight should be added 180°opposite to he locking nut on the wheels inboard side. When rotating tires and wheels, always make sure that the locking nut is placed near the valve stem.

This will help maintain good customer satisfaction.

Off-Vehicle Balancing

When balancing wheels off the vehicle, use a balancer which pilots the wheel by the center hole (not the lug holes) if possible.

Some electronic off-vehicle balancers are more accurate than the on-vehicle spin balancers, but do not correct drum or rotor unbalance. If the vibration is not corrected by the off-vehicle balance, an on-vehicle balance may also be needed. When doing this additional balance, do not remove the wheel weights from the electronic off-vehicle balance. Instead, split the new on-vehicle weights equally between the inner and outer rim flanges (to avoid disturbing the dynamic balance from the electronic off-vehicle balancer).

On-Vehicle Balancing

Front Wheels - Lift front of vehicle with floor jack under front cross member in center of vehicle to allow vehicle to vibrate while balancing. See Section OA of this manual for "Vehicle Lift Points".

Rear Wheel Balance:

1. Raise both rear wheels. See Section OA of this manual for "Vehicle Lift Points". Put jack stands under vehicle, but do not put vehicle weight on stands.

   CAUTION: Do not attempt to balance a tire on a limited-slip axle with the other drive wheel on the ground. The vehicle will move, resulting in personal injury and property damage.
2. Remove the other wheel and tire.
3. Reinstall lug nuts and tighten securely to retain the brake drum.
4. Balance the remaining wheel using engine power to spin the wheel.

   CAUTION: On vehicle which have limited-slip axle, drive wheel spin should be limited to 70 mph (113 km/h).
5. Reinstall the other wheel.

Wheel Weights

(Figure 3E-19)

Balancing of optional factory aluminum wheels requires the use of special clip-on or stick-on type wheel weights. These weights are designed to fit over the thicker rim flange of the aluminum wheel.

When balancing on the vehicle, do not remove the original balance weights from the off-the vehicle dynamic balance. If more than one ounce of additional weight is required, it should be split between the inner and outer rim flanges.

When using the stick-on type weights, follow the manufacturer's recommended procedure or use the following steps:

1. Wipe balance weight attachment area with naptha or a mixture of 50% by volume isopropyl alcohol and 50% by volume water. A clean cloth or paper towel must be used. A couple of passes with normal finger pressure is usually sufficient to clean area.
2. Dry the area with hot air. Surface of the wheel should be 70° minimum.
3. Make sure that the weights are at least room temperature (70°). (Warming plate may be needed).
4. Remove backing tape on back of balance weights. Caution must be used to avoid touching the adhesive surface before application.
5. Apply the weight by pressing on with hand pressure. NOTE: Do not mount weights on clear coat overspray areas.

VIBRATION ELIMINATION PROCEDURE

Prior to performing any work, always **road test** the vehicle with the customer, if at all possible.

Visual Inspection

1. Proper inflation pressure. See Figure 3E-3.
2. Bent rims from an ensuing chuckhole or curb impact.
3. Damaged tires, such as tread distortions, separations, or bulges. Slight sidewall indentations are normal and should not affect ride. Sidewall bulges are not normal and indicate impact damage.
4. Mud or debris build-up on the tire or wheel.
5. Replacement wheel/tire which does not conform to the original part, or is of lesser quality or substitute design.
6. Loose or missing - balance weights or wheel nuts.
7. Irregular or excessive tire wear.
8. Make sure that the tire is match mounted.
9. Bent or defective drive axle.

Road Test

Warm up the tires first to eliminate any flat spotting. This may be done during a road test.

Low-Speed Vibration

Less than 40 mph can be **RUNOUT** related.

High-Speed Vibration

GREATER than 40 mph can be the result of **IMBALANCE** , but may be a vectorial product of both runout and imbalance.

Perform Wheel Balance

Before removing the tire/wheel assembly from the vehicle, mark (use a crayon) the stud bolt nearest the valve stem for future reference. Also mark the vehicle position (left front, etc.) on each tire.

BALANCE is the easist procedure to perform and should, therefore, be done first if the vibration occurs at highway speeds. An off-vehicle two-plane dynamic balance should first be performed. This will correct any imbalance in the tire/wheel assembly. An on-vehicle finish balance may also be required. This will correct any brake rotor or drive axle. Follow the balancing procedures outlined.

If balance does not correct the highway speed vibration, or if the vibration is at low speeds, runout may be the probable cause. **RUNOUT** is a bit more time consuming to diagnose. It can be caused by the drive axle, tire, the wheel, or the way the wheel attaches to the vehicle.

Perform Runout Check

1. The free runout of the tire/wheel assembly should first be measured on the vehicle. A dial indicator with a roller wheel should be used. Lateral runout (side to side) should be measured on the tire's sidewall as close to the tread shoulder as possible. Radial runout (up and down) should be measured on the center tread rib. Some tread designs may require tightly wrapping a piece of tape around the center tread circumference for better dial indicator contact. Whether measuring radial or lateral runout, disregard any

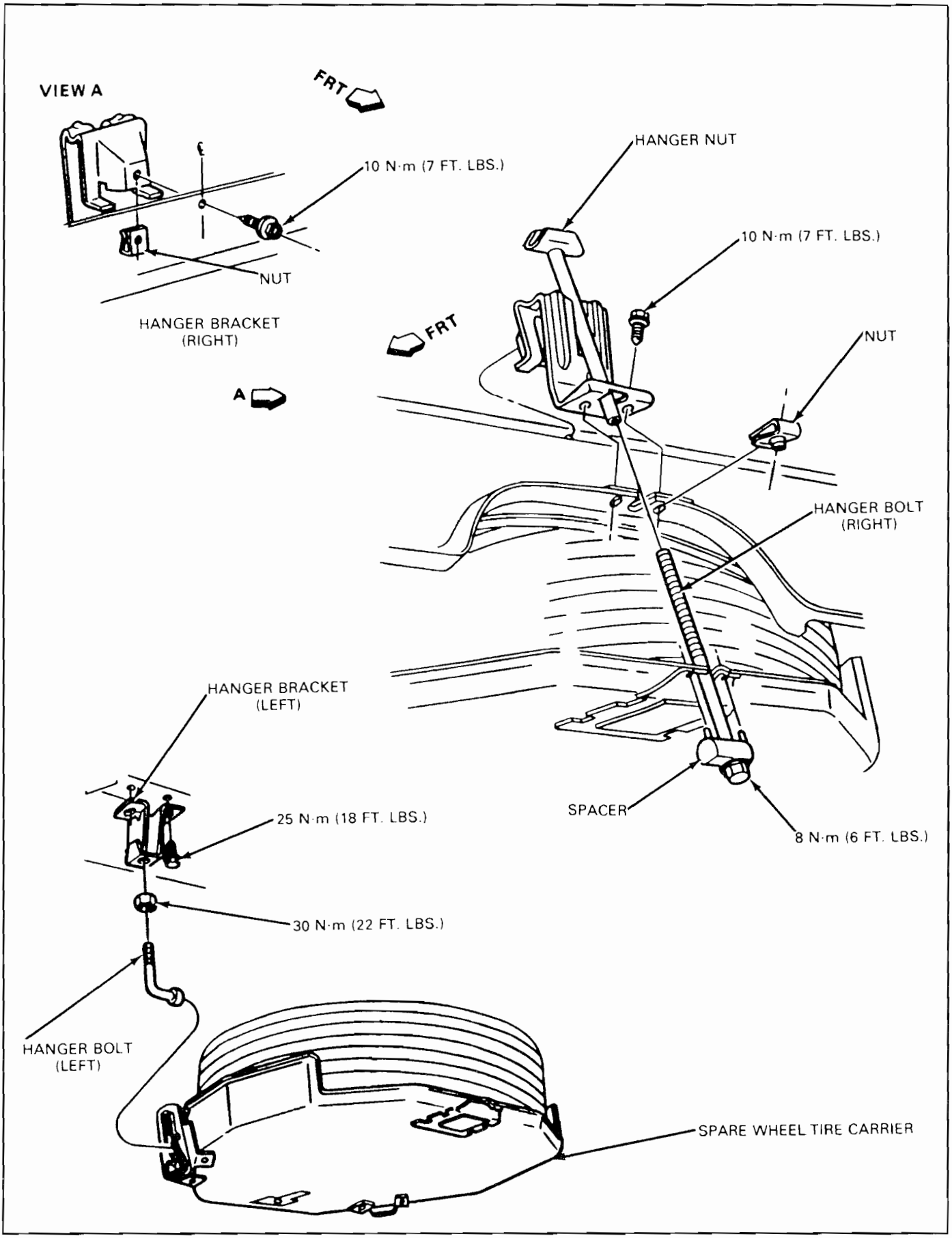


Figure 3E-17 Spare Tire Stowage

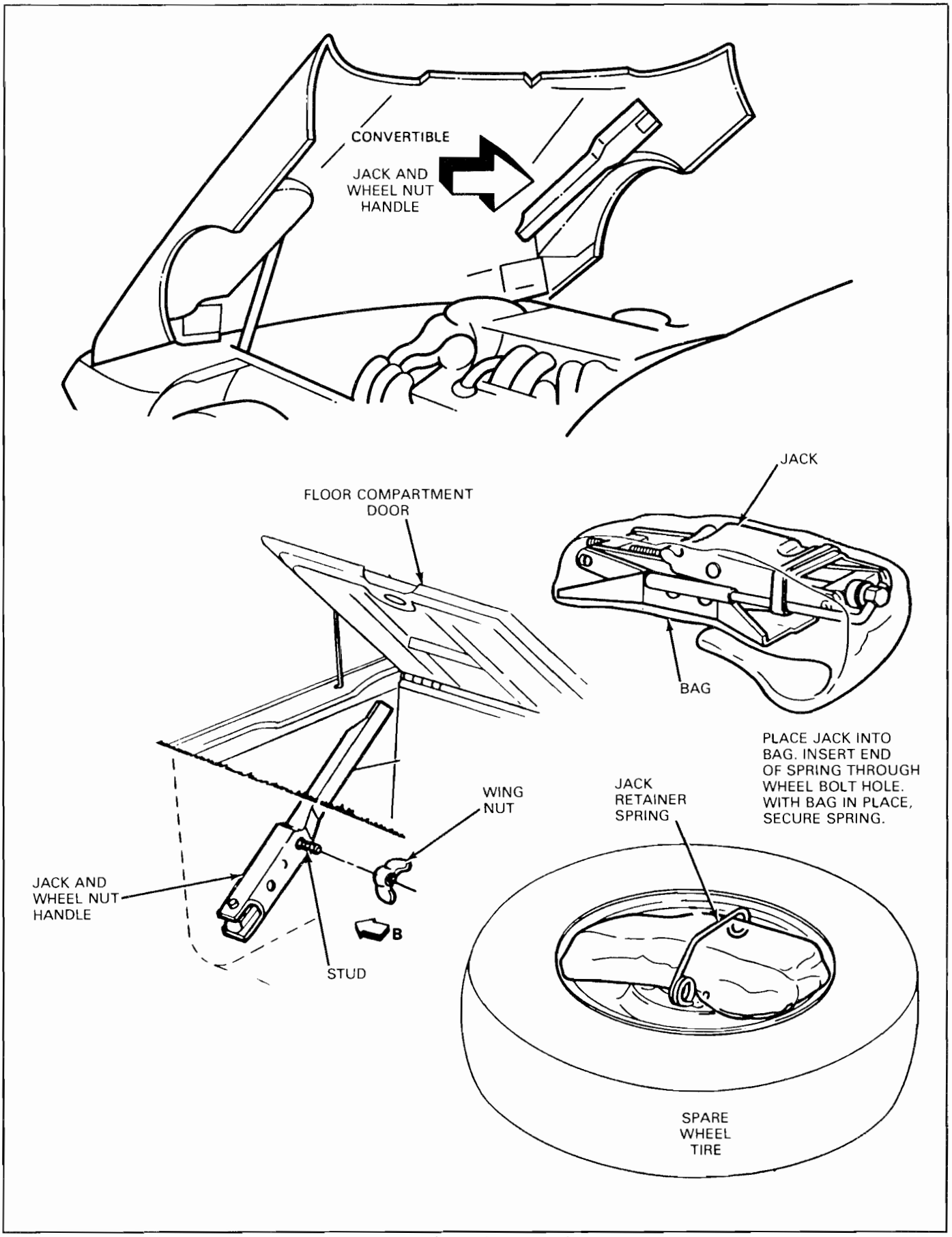


Figure 3E-18 Jack/Wheel Nut Handle Stowage

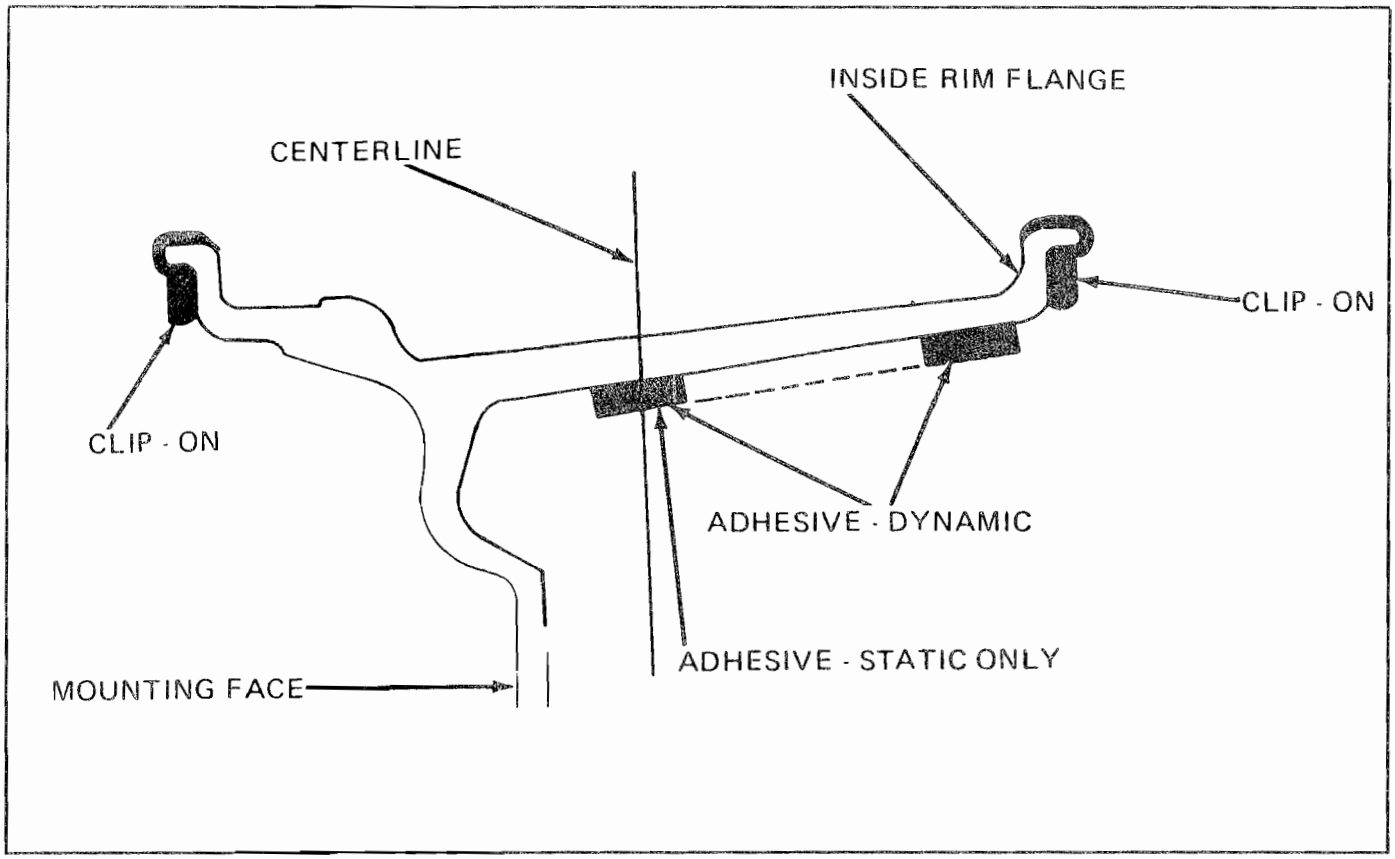


Figure 3E-19 Wheel Weight Placement

instantaneous indicator neeedle jumps due to sidewall depressions, tread blocks, etc. Record the total indicator reading, and the location of the high point of runout. If either measurement exceeds .060", proceed to Step 2.

2. If the radial or lateral runout measured in Step 1 exceeds .060", mount the tire/wheel assembly on a dynamic balance machine and again measure the amount of runout. Locate on the machine by the wheel's center pilot hole. Using the same procedure as in Step 1, record the amount of runout and its high point location. If either measurement, radial or lateral, exceeds .050", proceed to Step 3.
3. If the radial or lateral runout measured in Step 2 exceed .050", break down the assembly and rotate the tire on the rim 180°. Reinflate, mount on the dynamic balance machine, and again measure and record the radial and lateral runout, and its location, as in Step 2. In many cases, rotating the tire on the wheel will bring the assembly's runout into the acceptable range of less than .050". If not, proceed to Step 4.
4. If after rotating the tire 180° on the wheel, the radial or lateral runout still exceeds .050", and the high point has moved approximately 180° (followed the tire around the rim), the tire is the major contributor and should be replaced. If the second high point still exceeds .050", and is close to the original high point (relative to the rim), the wheel is the major contributor. Before replacing the wheel, break down the assembly and measure the wheel separately. Replace the wheel if radial runout exceeds .030" (aluminum wheels) or lateral runout exceeds .030" (aluminum wheels).
5. If the runout of the tire/wheel assembly is within limits when measured off the vehicle, yet exceeds the limits when measured on the vehicle, the attachment of the tire/wheel assembly to the hub is the probable cause. Rotate the assembly two stud bolts and recheck the runout. Several positions may have to be tired to find the best location. If the runout cannot be reduced to an acceptable level, remove the tire/wheel assembly and measure stud runout with the dial indicator. If stud runout exceeds .030", the hub or drive axle shaft should be replaced.

Whenever a tire is rotated on the rim, or a tire or wheel is replaced, the assembly must be rebalanced.

Force Variation

TIRE STIFFNESS variation, or **LOADED RADIAL RUNOUT** can also cause a vibration. However, this is difficult to measure without a **TPD** (Tire Problem Detector) or a loaded radial runout buffer.

The **TPD** is simply a roller drum that slowly rotates the tire, while under load, (mounted on the vehicle) measuring spindle movement.

The loaded radial runout buffer is a more automated machine that slowly rotates the tire under load with a roller drum off the vehicle and measures the tire's stiffness. It will then "match" the tire to the wheel by buffing off small amounts of rubber from the outer tread rows at the stiff spot. This procedure is

usually effective, especially when used as a measuring device and for fine buffing only. However, this equipment requires careful use so as to not remove too much rubber.

The above two methods will correct tire stiffness variation, tire runout, and wheel runout at the same time. However, because such equipment is not always available, and both have their disadvantages, the most basic procedure of measuring free runout with a dial indicator, as previously detailed, is usually more practical. The free runout of the tire will usually correspond with the tire's stiff spot.

Substitution Method

Install a known good set of tire/wheel assemblies. If these correct the vibration, the original assemblies should be reinstalled one at a time until the vibration returns.

CLEANING ALUMINUM WHEELS

The aluminum wheel should be washed and waxed as normal maintenance. More often when used in sand, mud or road salt.

Many aluminum wheel cleaners are available in the aftermarket. **No abrasive cleaners can be used.** They will damage the protective coating.

ALUMINUM WHEEL REFINISHING

A protective clear coating is applied to the surface of original equipment cast aluminum wheels. A surface degradation condition can begin to develop if frequent, repeated automatic car wash cleaning abrades or wears off the factory applied protective clear coating. This can happen at some automatic car wash facilities using agressive silicon carbide tipped tire brushes to clean white walls and tires. Once the protective clear coating is damaged, exposure to caustic cleaners and/or road salt further causes surface degradation. The service procedure details how to strip, clean and recoat those aluminum wheel rims that are affected by the above condition.

Required Materials

- 3M® Scotchbrite Cleaning Pad, Part No. 07445 or equivalent
- 3M® Brand Troubleshooter Chemical Stripper or equivalent
- 3M® Medium Buffing Compound, Part No. 05955 or equivalent
- 3M® Buffing Pad, Part No. 05701 or equivalent
- R & M® Pre Kleno Cleaner or equivalent
- R & M® Metal Conditioner, Part No. 801 or equivalent
- R & M® 893 2K Enamel Clearcoat and 894 Catalyst Hardener

Service Procedure:

CAUTION: Use of rubber gloves and eye protection is necessary to prevent personal injury.

1. Remove wheel(s) from the vehicle. This makes stripping, cleaning and recoating much easier.
   a. Remove wheel weight and mask off tire. Reference mark tire for reinstallation of weight after recoating of wheel.
2. Removal of original clear coating:
   a. Apply a chemical stripper such as 3M® Brand Troubleshooter to wheel rim surface.
   b. Wait 10-15 minutes, then wet scrub surface using a 3M® No. 98 Scotchbrite Cleaning Pad, Part No. 07455.
   c. Rinse surface thoroughly with clean water.
3. Removal of surface oxidation:
   a. Compound surface with 3M® Superbuff Buffing Pad, Part No. 05701 and medium type compound such as 3M® Part No. 05955 or No. 05931. This will remove any existing stain and oxidation from the wheel.
   b. After compounding, hose off rim with water and scrub with small brush to remove excess compound and air blow dry.
4. Recoating procedure (R & M®):
   a. Use Pre Kleno to clean surface of any surface contaminants.
   b. Apply No. 801 metal conditioner. It is recommended that rubber gloves be used for this application.
   c. Refer to label for specific directions. If No. 801 metal conditioner is used, make sure it is reduced one part metal conditioner with three parts water.
      (1) Apply metal conditioner with clean rag, keeping surface wet.
      (2) Wipe off carefully while still wet with clean, dry rag.
   d. After removing the original clear coating and preparing the surface, next apply R & M® 893 2K Clear with 894 Urethane Catalyst Hardener. Refer to label for specific directions.

CAUTION: When applying any two part component paint system, wear proper respiratory protection such as 3M® Paint Respirator, Part No. 06984, or Easi-Air Respirator, Part No. 06986 or equivalent.

Wheels should be allowed to air dry over night prior to tire installation.

SNOW TIRES

CAUTION: When snow tires are requested, it is MANDATORY (without compromise) that ALL four (4) wheels be mounted with snow tires; only a specific tread design can be used.

- Corvette - 1984 thru 1987.
- Tires - ONLY the Goodyear® "Eagle" M&S, or equivalent tread design can be used. Contact tire manufacture.
- Tire Size - P255/50 VR16.

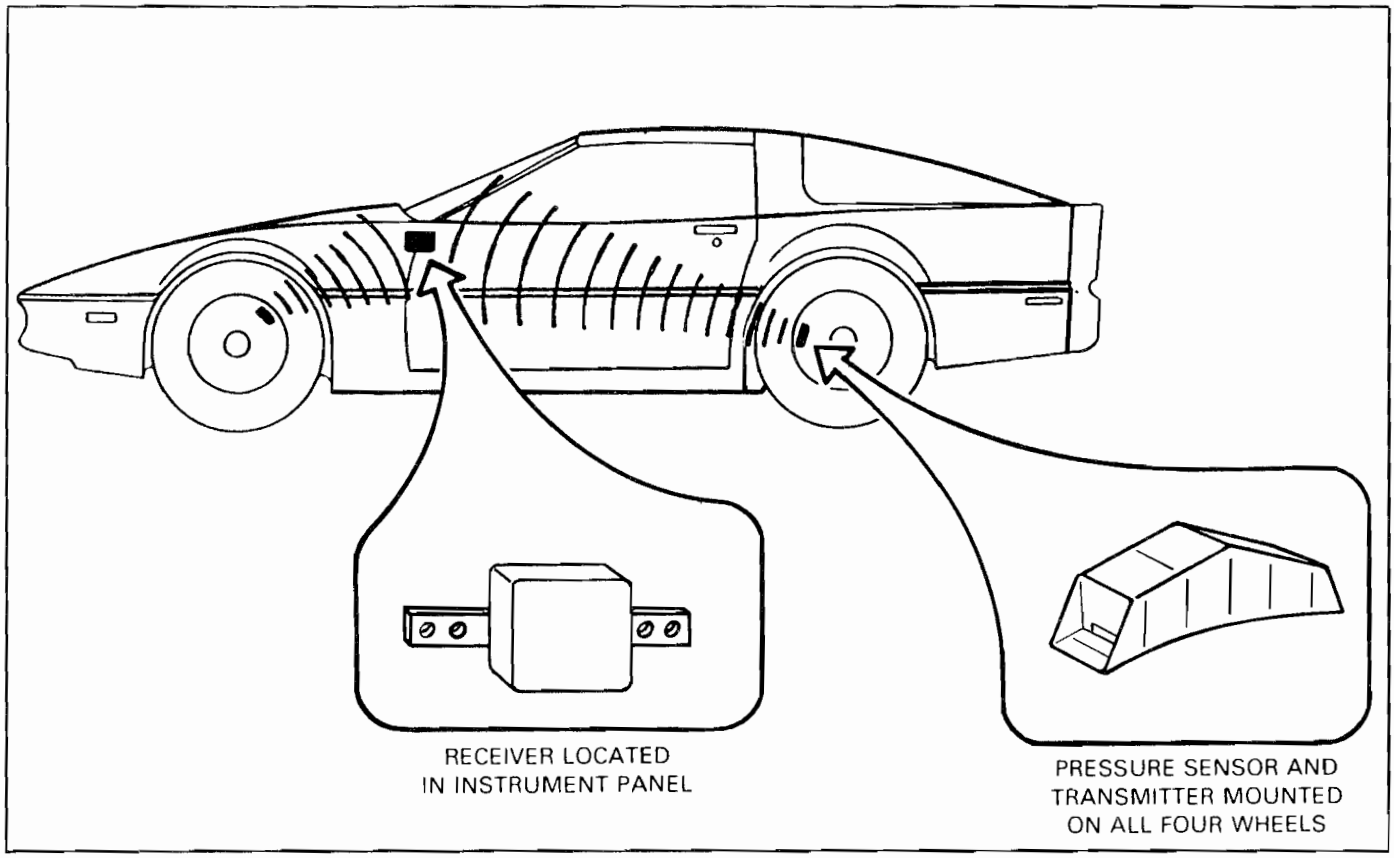


Figure 3E-20 Low Tire Pressure Warning System

LOW TIRE PRESSURE WARNING SYSTEM

Operation

(Figure 3E-20)

With a sensor transmitting module installed in each tire, and a receiver module installed in the instrument panel, the LTPWS performs as follows:

When the ignition switch is turned to the "Run" position, the Receiver/Display unit will audit itself (lamps, wiring, connections, microprocessor, lamp drivers, etc.) by illuminating the 2 associated lamps in the telltale cluster for 2 seconds. The lamps are: (1) "Low Tire Pressure" and (2) "Service LTPWS". If the lamps fail to illuminate, or if only one illuminates, or if they stay on, then the Receiver/Display ASM has failed its Power-On test.

With the loss of tire pressure (in one or more tires) below 20 PSI, the electronic code (signal) representing a low tire condition (with tire position data) is sent by the pressure switch within the tire sensor. No signal will be sent until the vehicle has moved sufficiently far for a "power generation cycle" to be completed (typically 30 seconds over 25 mph.) This power-cycle results from the wireless, batteryless, and patented method of generating electricity from the vibrations produced when the tire is ROLLING (Piezo-Electric). When the power cycle is complete, the miniature radio transmitter within the tire sensor is engaged for approximately 128 milliseconds during which pulse codes are sent to the dash-mounted receiver module. As long as the tire pressure remains below alarm set point, a repeat (low tire) radio transmission will occur every power cycle. (Though only one successful communication signal is necessary to activate the "Low Tire Pressure Lamp".

The Receiver portion of the Receiver/Display assembly is constantly "listening" for this electronically-coded low tire signal. And on successful reception and decode, it will illuminate the "LOW TIRE PRESSURE" lamp, located in the telltale cluster. This lamp will remain on until the ignition is switched off (No changes take place in the display when tires are inflated while leaving the car running). When the ignition is turned off, and back on, the receiver is completely reset requiring another low tire pressure signal from a sensor to indicate again.

During the normal operation, no telltale lamps are on. When the vehicle is moving, power cycles are occurring in each tire sensor as mentioned before. However, since tire inflation pressure is above the sensor switch set point, the receiver will not signal the "Low Tire Pressure Lamp" module.

The Receiver unit is also "listening" for Diagnostic Signals. At least one from each tire must be received during the time period called a "DIAGNOSTIC CYCLE". At the end of this Diagnostic Cycle, the Receiver Module checks that all sensors have reported. If they have all reported in (car moving - all sensors functioning), then no action is taken and another system Diagnostic Cycle begins. But if one, two or three wheel sensors have not reported (signaled), then the "Service LTPWS" telltale lamp is illuminated. The lamp will go out on either of 2 conditions: 1) Ignition switched off 2) All sensors signal again.

Vehicle Road Test

Turn ignition to run position, and the "LOW TIRE PRESSURE"and "SERVICE LTPWS" telltale lamps will illuminate for 2 seconds. Failure to do so indicates a possible blown fuse, receiver module disconnected, or faulty receiver module. Repeated failure to illuminate the lights could also mean a faulty indicator lamp. NOTE: This "Power On"test does not certify the receiver module If during sensor testing, no signals are obtained from ANY of the wheels, then it is likely the receiver module is faulty or all the wheels have been exchanged for ones without sensors -- look for wheel flange decal (LTPWS).

Remove air pressure from one tire on the vehicle below 20 PSI using an accurate gage, and drive the vehicle above 25 mph. Within two miles above that speed, the "LOW TIRE PRESSURE" lamp should illuminate. Failure to do so indicates a faulty tire sensor in that wheel location. Reinflate the tire and repeat the test for each of the other three (3) tires.

The receiver module in this system monitors each tire sensor by counting radio-signals from each sensor. This only occurs if the vehicle is rolling sufficiently fast to generate power in the sensors. If one or more sensors are not transmitting, or are missing from the wheel, the lamp should illuminate after driving for approximately 4 to 10 min. (regardless of tire pressures). If a sensor is intermittent the lamp may illuminate after a much longer period of time, or the lamp may go out after being lighted (indicating restoration of a lost sensor signal).

Garage Test Pressure (Optional)

This procedure may be performed without driving the car, but results are not as well defined.

Turn ignition to run. Reduce pressure in each tire in turn below 20PSI and tap hard and rapidly on the tire tread with a rubber mallet in the one-pound weight range (time required to get "LOW TIRE PRESSURE" lamp illumination will vary greatly but should not take more than 2 or 3 minutes of vibration). Remember that the objective here is to get mechanical energy to the sensor (strapped on the wheel 180° from valve stem) so it can transmit a low tire pressure radio signal, a pneumatic tool (not electric) may also vibrate the tire sufficiently. Reinflate each tire when finished before proceeding to the next tire. This will avoid possible vibration travel through the car, which might cause confusing signals from other deflated tires.

NOTE: Lack of signal from a tire does not prove that a sensor is dead when using this method. Follow these pointers:

- Not enough vibration in tire.
- Rear Wheel: Position the wheel with the valve stem to the rear of car.
- Front Wheel:Position the wheel with the valve stem forward.
- No sensor in tire.

Service

When the "service LTPWS" lamp comes on after a few minutes of driving and remains on until the ignition is turned off every time, then there is almost certainly a faulty or missing sensor in at least one of the tires. The receiver normally cannot turn on the lamp unless it is receiving and processing at least one tire signal. Far more rare would be drifting frequencies, radio signal strength changing, or solftware program failures causing a continuous or intermittent lamp. In these rare cases the problem cannot easily be pinpointed. Replace one wheel sensor at a time and then the receiver, until the problem is corrected. Another possible reason would be dupiicate parts in the wheels (Four distinct part numbers must be on the four wheels.) If the lamp comes on as above, but goes off by itself, after continued driving, then the system has recovered from its error condition. This is acceptable, unless it occurs frequently and generally persists longer than 5 minutes while driving between 25 and 55 mph.

EVEN WITH THE "SERVICE LTPWS" LAMP ON, LOW TIRE PRESSURES MAY BE INDICATED CORRECTLY AT ANY TIME. NEVER IGNORE A LOW TIRE PRESSURE WARNING LAMP.

When the ignition key is turned during engine start, both lamps illuminate briefly for a bulb check test. If these lamps fail to illuminate or if only one illuminates or if they remain on, you should see your authorized dealer as soon as practical for service of the system.

The Low Tire Pressure Warning System can advise of many potential problems, but does not substitute for normal tire maintenance. Inspect tires regularly and check pressure.

> **NOTICE:** Drivers must still exercise their own recognition of severe tire damage due to road hazards or other conditions that might result in sudden tire failure.

Sensor ASM-RF	14093295
Sensor ASM-RR	14093296
Sensor ASM-LR	14093297
Sensor ASM-LF	14093298
Receiver Module	14093187

WHEEL SENSOR

SYMPTOMS	REASONS	CORRECTIVE ACTION
Low tire warnings regardless of true tire pressure (30 PSI or more).	One or more sensors stuck in low tire state.	Replace wheel sensor.
Lamp comes on while driving and never goes off until IGN off.	One or more sensors failed to signal during all diag. cycles.	Replace wheel sensor.
Lamp comes on while driving but goes out after a period of time and happens repeatedly.	A sensor is communicating intermittently.	Replace wheel sensor. Allow further driving until sensor fails or replace all sensors.
	Receiver is receiving intermittently.	Allow further driving until failure or replace receiver.
	Excessive electric noise from blower or wiper.	Check component capacitors.

Figure 3E-21 Wheel Sensor

RECEIVER MODULE

SYMPTOMS	REASONS	CORRECTIVE ACTION
IGN on, no lamps	One or both lamps burned out.	Replace w/#194.
	Fuse blown.	Replace fuse.
	Disconnected.	Reconnect.
	Faulty receive module.	Replace.
IGN on, 2 sec lamp but won't extinguish (or otherwise erratic power-up)	Power not interrupting during crank cycle (should be).	Connect properly to crank - interrupted power.
	Dirty or oxidized plug or keyswitch.	Replace keysw, clean plug or repair wires.
	Module not reseting.	Replace receive module.
	Battery excessively low.	Check batt. & charge syst.
PWR-up OK but won't indicate low tire during tests.	Radio section off-frequency or not working.	Replace receiver module.
	All sensors missing, wheels exchanged, etc.	Reinstall wheel sensors.
	Faulty filter capacitor on wiper or fan motor (electric radio noise in receiver).	Replace.
Fault lamp comes on occasionally during or shortly after long periods of idle or driving under 25 MPH. Turns off again after driving further or faster.	Normal operation. Not a problem, but does correctly indicate "system partly-disabled" status when lamp is on.	

Figure 3E-22 Receiver Module

WHEEL NUT TORQUE

All Wheels	140 N·m (100 ft. lbs.)
Spare	110 N·m (80 ft. lbs.)

SECTION 4A

PROPELLER SHAFT AND UNIVERSAL JOINTS

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate location by the terminology "See Notice on page 1 of this Section."

NOTICE: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

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GENERAL DESCRIPTION

UNIVERSAL JOINTS

The simple universal joint, as used on most vehicles is basically two Y-shaped yokes connected by a crossmember called a spider. The spider is shaped like an X and arms that extend from it are called trunnions (Figure 4A-1).

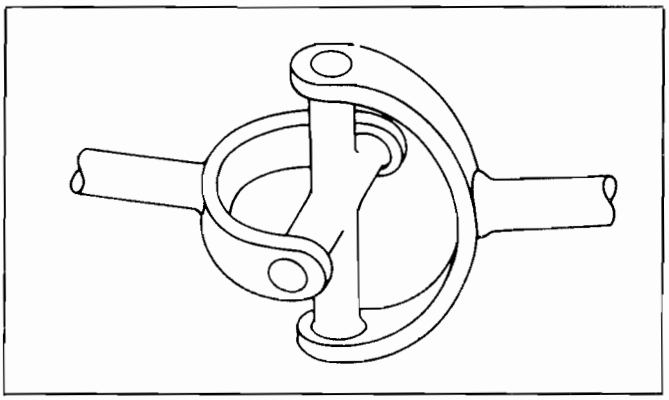


Figure 4A-1–Simple Universal Joint

The spider allows the two yoke shafts to operate at an angle to each other. When torque is transmitted at an angle, through this type of joint, the driving yoke rotates at a constant speed while the driven yoke speeds up and slows down twice per revolution. This changing of velocity (acceleration) of the driven yoke increases as the angle between the two yoke shafts increases. This is the prime reason why single universal joints are not used for angles greater than three to four degrees. At four degrees, for example the change of velocity is .5%. At ten degrees it is 3%. If the universal joint were set at 30 degrees and the driving yoke were turning at 1000 RPM the velocity of the driven yoke would change from 866 RPM to 1155 RPM in one quarter of a revolution. In the remaining quarter revolution the velocity would change from 1155 RPM to 866 RPM.

On a one-piece drive shaft this problem can be eliminated by arranging two simple universal joints so that the two driving yokes are rotated 90 degrees to each other. However, the angle between the drive and driven yokes must be very nearly the same on both joints for this to work (Figure 4A-2). This allows the alternate acceleration and deceleration of one joint to be offset by the corresponding deceleration and acceleration of the second joint. When the two joints do not run at approximately the same angle, operation

can be rough and an objectionable vibration can be produced.

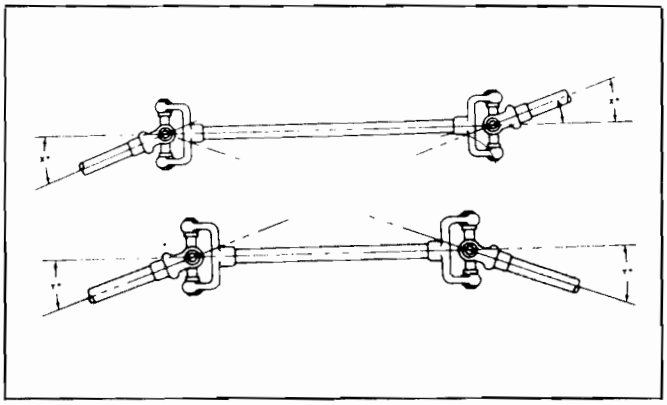


Figure 4A-2–Universal Joints Arranged for Constant Velocity

Universal joints are designed to consider the effects of various passenger loadings and rear axle windup, during acceleration. Within the design angle variations the universal joints will operate safely and efficiently. However, when the design angles are exceeded the operational life of the joints may decrease.

The bearings used in universal joints are the needle roller type. The needle rollers are held in place on the trunnion by round bearing cups. The bearing cups are held in the yoke by either (depending on the manufacturer) snap rings or plastic injection. These joints are lubricated for life and cannot be lubricated while in the vehicle.

DRIVE SHAFTS

The Corvette uses two type of drive shafts, one shaft uses an aluminum tube and the other shaft uses a steel tube. The drive shaft is used to transmit power from the transmission output shaft to the differential. Each shaft is installed in the same manner. A universal joint and splined slip yoke is located at the transmission end of the shaft, where they are held in alignment by a bushing in the transmission rear extension. The slip yoke permits fore and aft movement of the drive shaft as the differential assembly moves up and down. The spline is lubricated internally by transmission lubricant. An oil seal at the transmission prevents leakage and protects the slip yoke from dust, dirt, and other harmful material.

The rear universal joint is attached by two straps at the companion flange at the rear axle.

The drive shaft requires very little service. The universal joints are lubricated for life and cannot be lubricated while in the vehicle. A service kit, which consists of a cross with bearing cup assemblies and bearing retainers must be installed on the vehicle if a universal joint becomes worn or noisy. If it becomes necessary to service a universal joint, the entire drive shaft must be removed from the vehicle.

Since the drive shaft is a balanced unit, it should be kept completely free of undercoating and other foreign material which could upset shaft balance.

When reinstalling the prop shaft, align the black paint spot on the prop shaft 180° opposite the yellow paint spot on the companion flange. This aligns the light side of the prop shaft with the heavy side of the companion flange, minimizing residual unbalance.

DIAGNOSIS

To determine whether the propeller shaft is causing the problem, drive vehicle through speed range and note speed (Vehicle and/or engine) at which problem is most pronounced (tachometer may be used). Shift transmission into a lower gear range and drive vehicle at same engine speed as when problem was most pronounced in direct drive. Note effect on problem.

To determine engine speed, if tachometer is not used, divide vehicle speed by the transmission gear ratio in which the problem occurs.

If the problem is still present at the same engine speed whether in direct drive or in the lower gear range, since the propeller shaft speed varies, it cannot be at fault. If problem decreases or its eliminated, in a different gear range but at the same engine speed, check the possible causes listed on chart.

CHECKING PROPELLER SHAFT BALANCE

Hose Clamp Method

1. Place the vehicle on a twin post hoist so that the rear of the vehicle is supported on the rear spindle support rods and the rear wheels are free to rotate. Remove both rear tire and wheel assemblies and install plain or conventional wheel lug nuts with flat side next to brake rotor.
2. Mark and number propeller shaft at four (4) points 90 degrees apart at rear of shaft just forward of balance weight.
3. Install two (2) hose clamps on the rear of the propeller shaft and slide them rearward until the clamps stop at the nearest balance weight welded to the tube. Align both clamps to any one of the four marks made on shaft in Step 2. Tighten the clamps (Figure 4A-5). Be sure sufficient clearance is maintained so that clamp heads do not contact floor pan of vehicle. In order to gain sufficient clearance, it may be necessary to position the clamps over the balance weights.
4. Run the vehicle through the speed range to 80-90 MPH (130-145 km/h). Note amount of unbalance.

   CAUTION: All personnel should stay clear of driveline joint and balance weight area to avoid possible injury. Do not run vehicle on hoist for extended periods due to danger of overheating the transmission or engine.
5. Loosen clamps and rotate clamp heads 90 degrees to the next mark on shaft. Tighten clamps and repeat Step 4.
6. Repeat Step 5 until vehicle has been run with clamp heads located at all four marks on shaft.
7. Position clamps at point of minimum unbalance. Rotate the clamp heads away from each other 45 degrees. (Each way from the point of minimum unbalance). Run the vehicle and note if unbalance has improved (Figure 4A-6).

COMPLAINT	POSSIBLE CAUSE	CORRECTION
Roughness, Vibration or Body Boom at any speed. NOTE: With tachometer installed in vehicle, determine whether propeller shaft is cause of complaint by driving through speed range and note the engine speed (rpm) at which vibration (roughness) is most pronounced. Then , shift transmission to a different gear range and drive vehicle at same engine speed (rpm) at which vibration was noted before. Note the effect on the vibration in each transmission gear range. If vibration occurs at the same engine speed (rpm) regardless of transmission gear range selected, drive shaft assembly is not at fault, since the shaft speed (rpm) varies. If vibration decreased, or is eliminated, in a different gear range but at the same engine speed (rpm), check the possible causes:	a. Bent or dented drive shaft. b. Undercoating on drive shaft. c. Tire unbalance. (30-80 mph, not throttle conscious) d. Worn universal joints. e. Burrs or gouges on companion flange. Check snap ring locating surfaces on flange yoke. f. Excessive drive shaft or companion flange unbalance, or runout. g. Excessive looseness at slip yoke spline. h. Drive shaft runout (50-80 mph throttle conscious)	a. Replace. b. Clean drive shaft. c. Balance or replace as required.* d. Overhaul, replacing necessary parts. e. Rework or replace companion flange. f. Check for missing balance weights on drive shaft. Remove and reassemble drive shaft to companion flange, 180° from original position. g. Replace necessary parts. h. Check drive shaft runout at front and rear. Should be less than specified. If above, rotate shaft 180° and recheck. If still above specified, replace shaft.
Scraping noise.	a. Slinger, companion flange, or end yoke rubbing on rear axle carrier.	a. Straighten slinger to remove interference.
Roughness — above 35 mph felt and/or heard.	a. Tires unbalanced or worn.	a. Balance or replace as required.

*NOTE: Out-of-round tires cannot be corrected with balance weights. If vehicle disturbance remains after tire balance, recheck with rear wheels and tires removed.

Figure 4A-3–Diagnosis Chart

COMPLAINT	POSSIBLE CAUSE	CORRECTION
Leak at front slip yoke. NOTE: An occasional drop of lubricant leaking from splined yoke is normal and requires no attention.	a. Rough outside surface on splined yoke. b. Defective transmission rear oil seal.	a. Replace seal if cut by burrs on yoke. Minor burrs can be smoothed by careful use of crocus cloth or honing with a fine stone. Replace yoke if outside surface is rough or burred badly. b. Replace transmission rear oil seal. c. Bring transmission oil up to proper level after correction.
Knock in drive line, clunking noise when car is operated under floating condition at .0 mph in high gear or neutral.	a. Worn or damaged universal joints. b. Side gear hub counterbore in differential worn oversize.	a. Disassemble universal joints, inspect and replace worn or damaged parts. b. Replace differential case and/or side gears as required.
Ping, Snap or Click in drive line. NOTE: Usually occurs on initial load application after transmission has been put into gear, either forward or reverse.	a. Loose upper or lower control arm bushing bolts. b. Loose companion flange.	a. Tighten bolts to specified torque. b. Remove companion flange, turn 180° from its original position and reinstall. Tighten pinion nut to specified torque.

Figure 4A-4–Diagnosis Chart

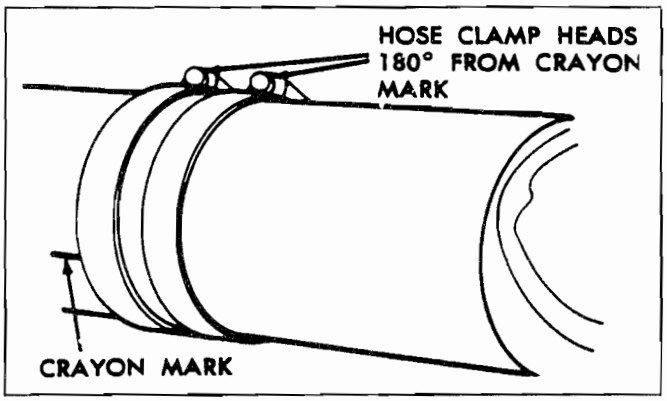


Figure 4A-5–Balance Hose Clamps in Place

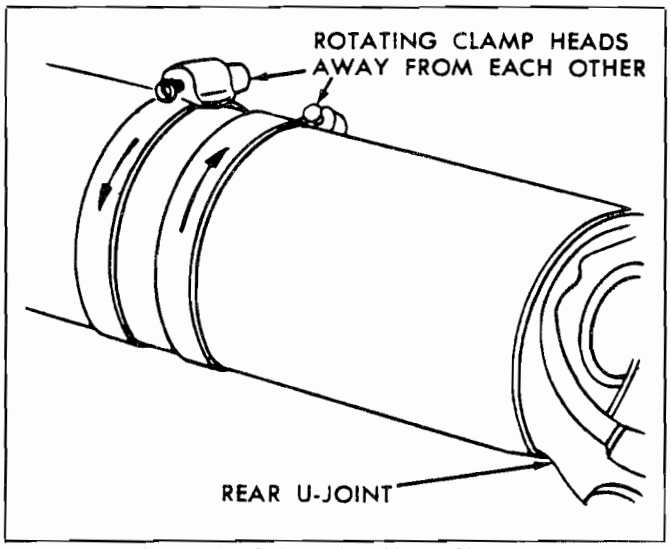


Figure 4A-6–Rotating Hose Clamps

In some cases, it may be necessary to use one clamp or possibly three clamps in order to obtain a good balance. Replace shaft if three hose clamps do not improve the unbalanced condition.

8. Continue to rotate the clamps apart in smaller angular increments until the "feel" for unbalance is best.
9. Reinstall tire and wheel assemblies and road test the vehicle for final check of balance. Vibration felt in the vehicle on the hoist may not show up in a road test, which is the final determining factor.

Strobe Light Method

If a wheel balancer of the type that is equipped with a strobe light is available, the use of such a unit will facilitate the balancing of the drive shaft. The balance pick-up unit should be placed directly under the nose of the rear axle carrier and as far forward as possible.

1. Place the vehicle on a twin post hoist so that the rear of the vehicle is supported on the rear spindle support rods and the rear wheels are free to rotate. Remove both rear tire and wheel assemblies and reinstall wheel lug nuts with flat side next to brake rotor.
2. Mark and number drive shaft at 4 points 90 degrees apart at rear of shaft just forward of balance weights.

3. Place strobe light wheel balancer pick-up under the nose of the differential.
4. With vehicle running in gear at vehicle speed where disturbance is at its peak, allow the driveline to stabilize by holding at constant speed. Point strobe light up at the spinning shaft and note position of one of these reference numbers. Shut off engine and position the drive shaft so that the reference numbers will be in the same position as was noted with strobe while the shaft was rotating. When strobe light flashed, the heaviest point of the shaft was down (6 o'clock) and to balance this shaft, it will be necessary to apply the balancing weight 180 degrees away from the heaviest point or at the top of the shaft (12 o'clock).
5. Install two screw-type hose clamps on the drive shaft as close to the rear as possible. Position both clamp heads 180 degrees from the heavier point of drive shaft as indicated by strobe light. Tighten clamps (Figure 4A-5).

   NOTICE: Be sure sufficient clearance is maintained so that clamp heads do not contact driveline support beam or floor pan of vehicle. In order to gain sufficient clearance, it may be necessary to position the clamps over the balance weights.

6. Run vehicle through the problem speed range. If disturbance is gone, nothing further need be done on the hoist. If the disturbance is not gone and the strobe light shows the clamp heads at the bottom (6 o'clock) of the shaft, go to Step 7. If the strobe light shows the two clamp heads at the top of the shaft, add one more hose clamp and recheck. If the strobe light shows the three clamp heads at the top of the shaft, remove the shaft and reinstall it 180 degrees on the rear flange. Recheck balance with no clamps. Repeat balance starting with Step 5. If the shaft still needs more than three hose clamps at the same clock position, replace the shaft. However, if the clamps are also 180 degrees from their original position after the shaft was rotated 180 degrees, the drive flange on the axle is out of balance and must be replaced. DO NOT use more than three hose clamps to balance the shaft. If the strobe light shows the hose clamps at the bottom of the shaft, but the disturbance still exists, go to Step 7.
7. Rotate two of the hose clamps equally away from each other toward the top (one each way from the original position as shown in Figure 4A-7, in small increments until best balance is achieved.

   In some cases, it may be necessary to use one clamp or possibly three clamps in order to obtain a good balance. Replace shaft if three hose clamps do not correct problem.
8. Install wheels and road test vehicle for final check of balance.

   Vibration felt in the vehicle on the hoist may not show up in a road test, which is the final determining factor.

CHECKING PROPELLER SHAFT

If a noise or vibration is present at high speed, check for damaged propshaft, missing balance weight on propeller shaft and/or companion flange or damaged universal joint, replace as required. When replacing companion flange, check for runout after installation of new part . If no damage or missing weight is found, remove propshaft and reindex by rotating 180 degrees at companion flange and reinstall shaft. Retest vehicle.

CHECKING COMPANION FLANGE RUN-OUT

Check companion flange run-out using tool J-35819 Companion Flange Run-out gage and J-8001 Dial Indicator or equivalent. Instructions are included with tool. Record run-out and mark high and low point of companion flange.

A. If companion flange run-out is .006″ or less, remove companion flange balance weight, if used. No further action is required.
B. If companion flange run-out is over .006″ but less than .011″ and balance weight is at or near low point of companion flange run-out, no further action is required.

   If balance weight is not at or near low point of companion flange run-out, remove weight. No further action is required.
C. If companion flange run-out is over .011″ but no greater than .015″ and balance weight is at or near low point of companion flange run-out, no further action is required.

   If balance weight is not at or near low point of companion flange runout, remove weight and reindex companion flange until run-out is .010″ or less.

   If impossible to achieve .010″ or less run-out, install a new companion flange and recheck for .010″ or less run-out.

   Service replacement companion flanges are not equipped with balance weights and should not be added.

ON VEHICLE SERVICE

PROPELLER SHAFT

Removal

1. Raise vehicle on hoist.
2. Remove the upper and lower underbody braces on vehicles equipped with a convertible top.
3. Remove the complete exhaust system as an assembly by:
   a. Disconnect A.I.R. pipe at the converter.
   b. Disconnect A.I.R. pipe clamps at exhaust pipe.
   c. Disconnect oxygen sensor electrical lead.
   d. Remove the exhaust hanger bolts at the driveline support beam.
   e. Remove the bolts attaching the mufflers to the hangers.
   f. Remove hanger bracket at the converter.
   g. Disconnect the exhaust from the exhaust manifolds and remove the exhaust system.

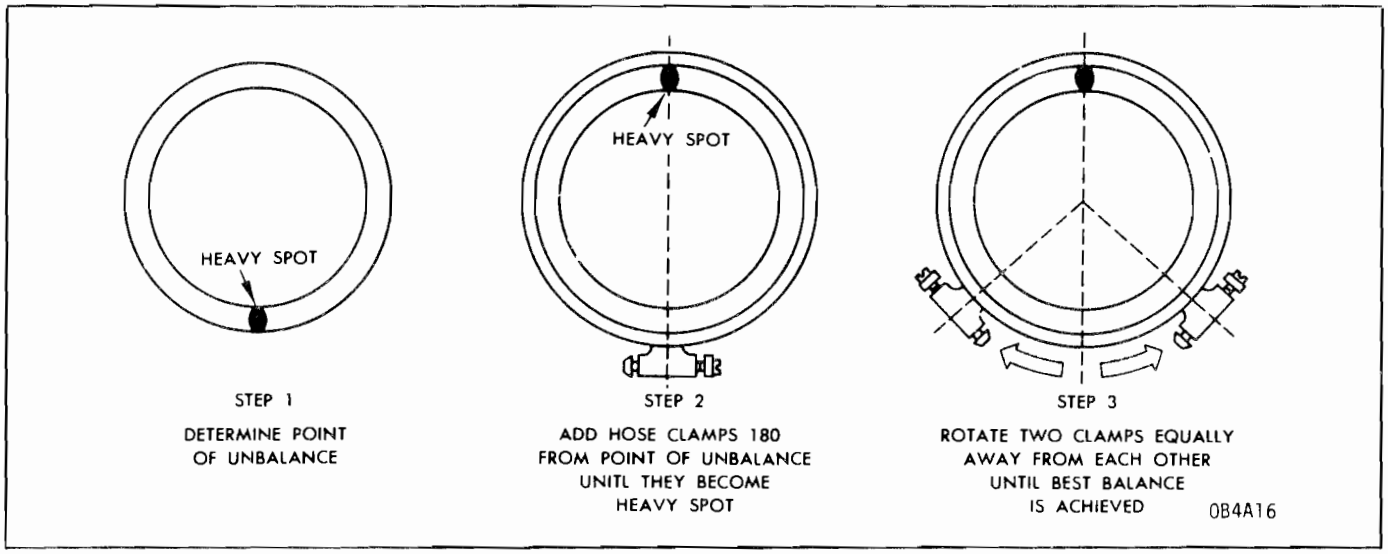


Figure 4A-7–Positioning Hose Clamps to Achieve Best Balance

4. Support the transmission.
5. Remove the bolts attaching the driveline support beam at the axle and transmission. Remove driveline support beam from the vehicle as outlined in the Rear Suspension Section (3D).
6. Mark relationship of shaft to companion flange and disconnect the rear universal joint by removing trunnion bearing straps. Tape bearing cups to trunnion to prevent dropping and loss of bearing rollers.
7. Slide slip yoke from the transmission and remove shaft. Watch for oil leakage from transmission output shaft housing.
8. Inspect yoke seal in the transmission extension, replace if necessary as described in the Transmission Sections (7A or 7B).

Installation

1. Align propeller shaft with companion flange using reference marks established in "Removal" procedure; remove tape used to retain trunnion bearing caps; connect exposed bearing caps to companion flange. Torque retaining strap bolts to 17 N·m (150 in. lbs.).
2. To install, reverse the removal procedures.
   - Refer to the Rear Suspension Section (3D) for driveline support beam installation, sealers and torque specifications.
   - Refer to the Exhaust System Section (6F) for installation and torque specifications.
   - Refer to the Body Section for upper and lower underbody brace installation and torque specifications.

UNIT REPAIR

UNIVERSAL JOINT

Replacement (Figure 4A-8)

The universal joints are of the extended- life design and do not require periodic inspection of lubrication; however, when these joints are disassembled, repack bearings and lubricate reservoir at end of trunnions with chassis lubricant. Use care not to loosen or damage dust seals. If dust seals are loose or damaged, entire U-joint must be replaced.

1. For reassembly purposes, indicate front of propeller shaft by scribing line on transmission end of shaft and on yoke.
2. Remove bearing lock rings from trunnion yoke (Figure 4A-9).
3. Support trunnion yoke on a piece of 1-1/4" I.D. pipe on an arbor bed.

   Due to length of the propeller shaft it may be more convenient to use a bench vise, for removal and installation, instead of an arbor press. In this case, proceed with disassembly and assembly procedure as with an arbor press.

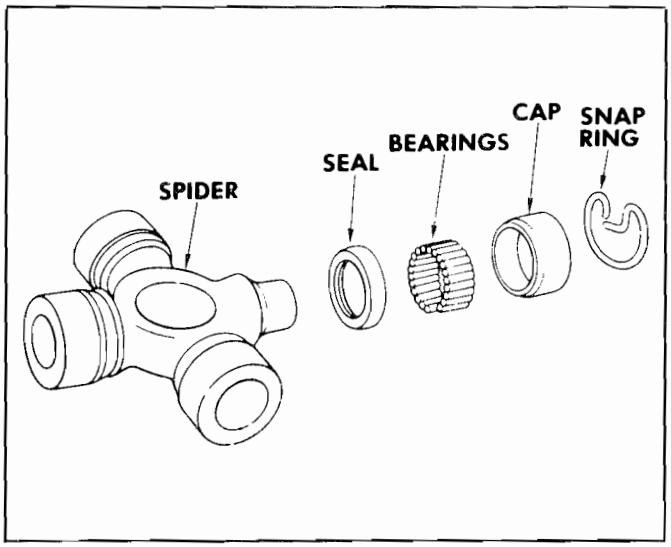


Figure 4A-8–Universal Joint Assembly

4. Using a suitable socket or rod, press on trunnion until bearing cup is almost out. Refer to Figures 4A-10 and 11. Grasp cup in vise and work cup out of yoke.

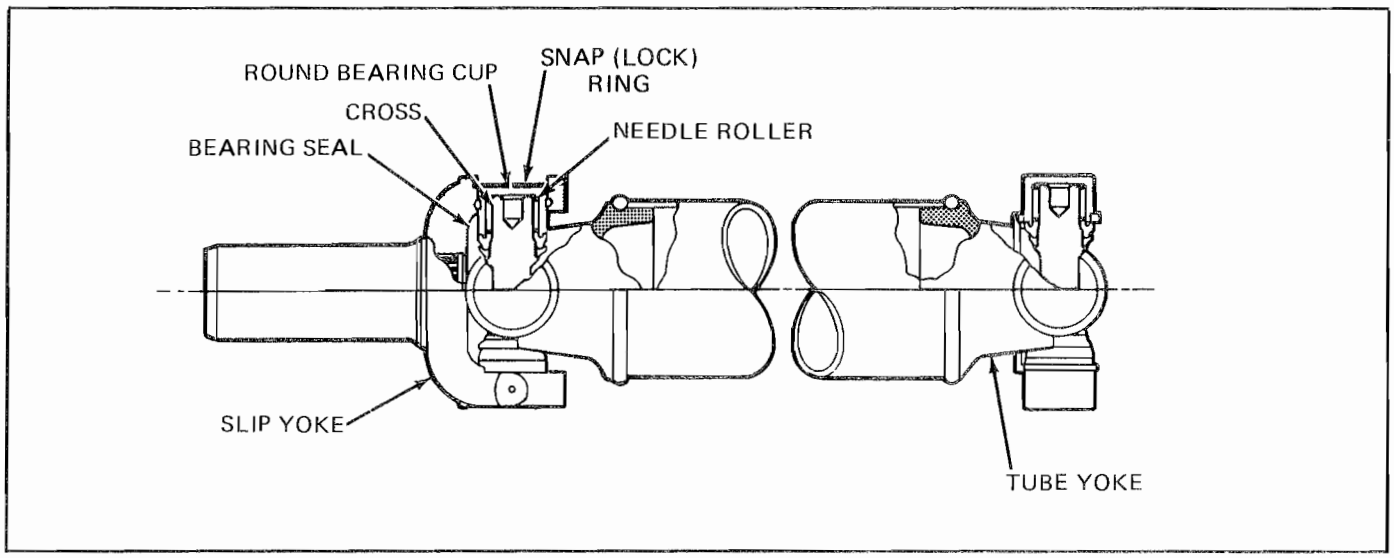


Figure 4A-9–Propeller Shaft Construction

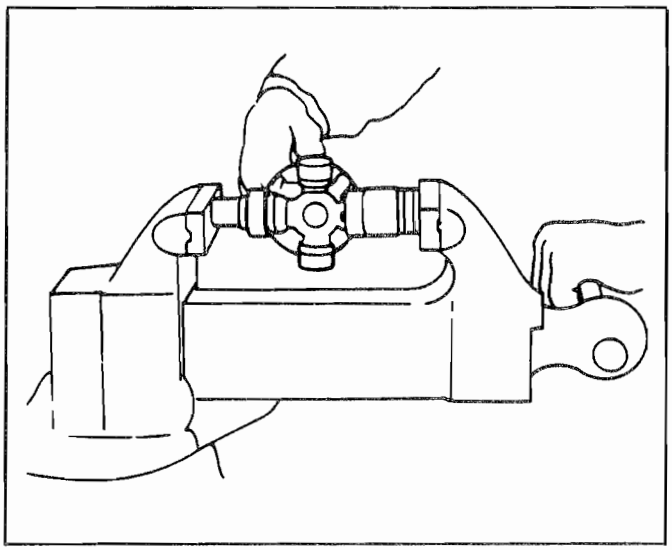


Figure 4A-10–Removing Bearing Cup - Vise

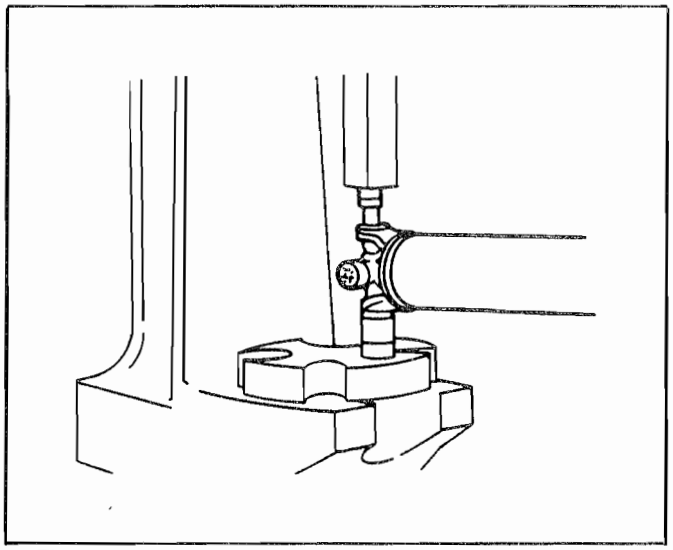


Figure 4A-11–Removing Bearing Cup - Arbor Press

5. Press trunnion in opposite direction and remove other cup as in step 3.
6. Clean and inspect dust seals, bearing rollers, and trunnion. Relubricate bearings as indicated in Maintenance and Lubrication Section.
   In addition to packing the bearings, make sure that the lubricant reservoir at the end of each trunnion is completely filled with lubricant. In filling these reservoirs, pack lubricant into the hole so as to fill from the bottom (use of squeeze bottle is recommended). This will prevent air pockets and ensure an adequate supply of lubricant.
7. Attach transmission yoke on front of shaft as marked in Step #1. **Failure to do so could result in driveline vibration.**
8. Position trunnion into yoke. Partially install one bearing cup into yoke. Start turnnion into bearing cup. Partially install other cup. Align trunnion into cup, and press cups into yoke. Use care not to dislodge dust seal.
9. Install lock rings.

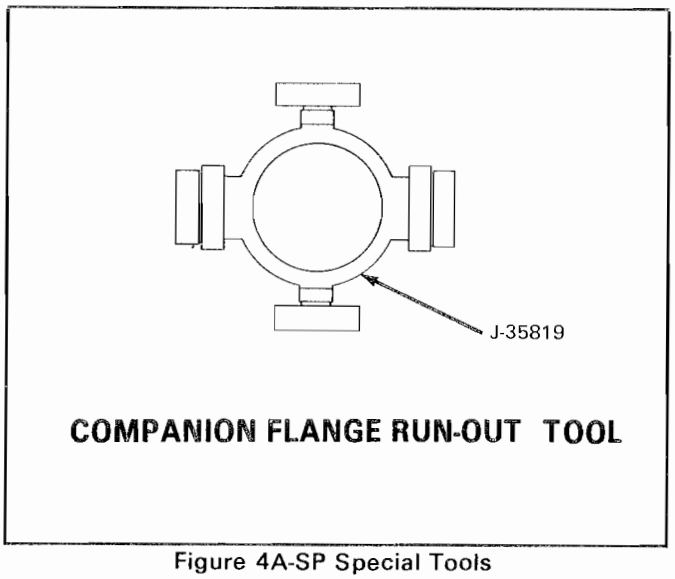


Figure 4A-SP Special Tools

SECTION 4B

REAR AXLE

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Notice on page 1 of this Section".

NOTICE: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

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GENERAL DESCRIPTION

The service procedures in this section cover the Dana Models 36 (7.875" ring gear axle) and 44 (8.5" ring gear axle). Both rear axle carriers are made of aluminum.

The Model 36 axle will be used in vehicles with an automatic transmission, while the Model 44 will be used in vehicles with a manual transmission.

The rear axles are of the semi-floating type where the differential carrier housing encloses the differential case and hypoid gears. The differential carrier housing and cover beam are made of light weight aluminum. The cover beam and support beam as shown in Figure 4B-12 are attached to the differential carrier supporting the rear portion of the drivetrain. Torque is transmitted through universal joints and axle shafts to the wheels.

The internal components of the carrier are of conventional design, incorporating a hypoid gear set with an overhung pinion supported on two pre-loaded, tapered roller bearing assemblies, and a two-pinion differential assembly supported on tapered roller bearings. Pinion mounting distance adjustments are made through the use of shims, as are the differential bearing preload and backlash adjustments. The differential side gears drive two splined yokes which are retained laterally by snap rings located on the yoke splined end. The yokes are supported on needle bearings pressed into the carrier, adjacent to the differential bearings. A lip seal pressed in outboard of the bearings, prevents oil leakage and dirt entry (Figure 4B-1).

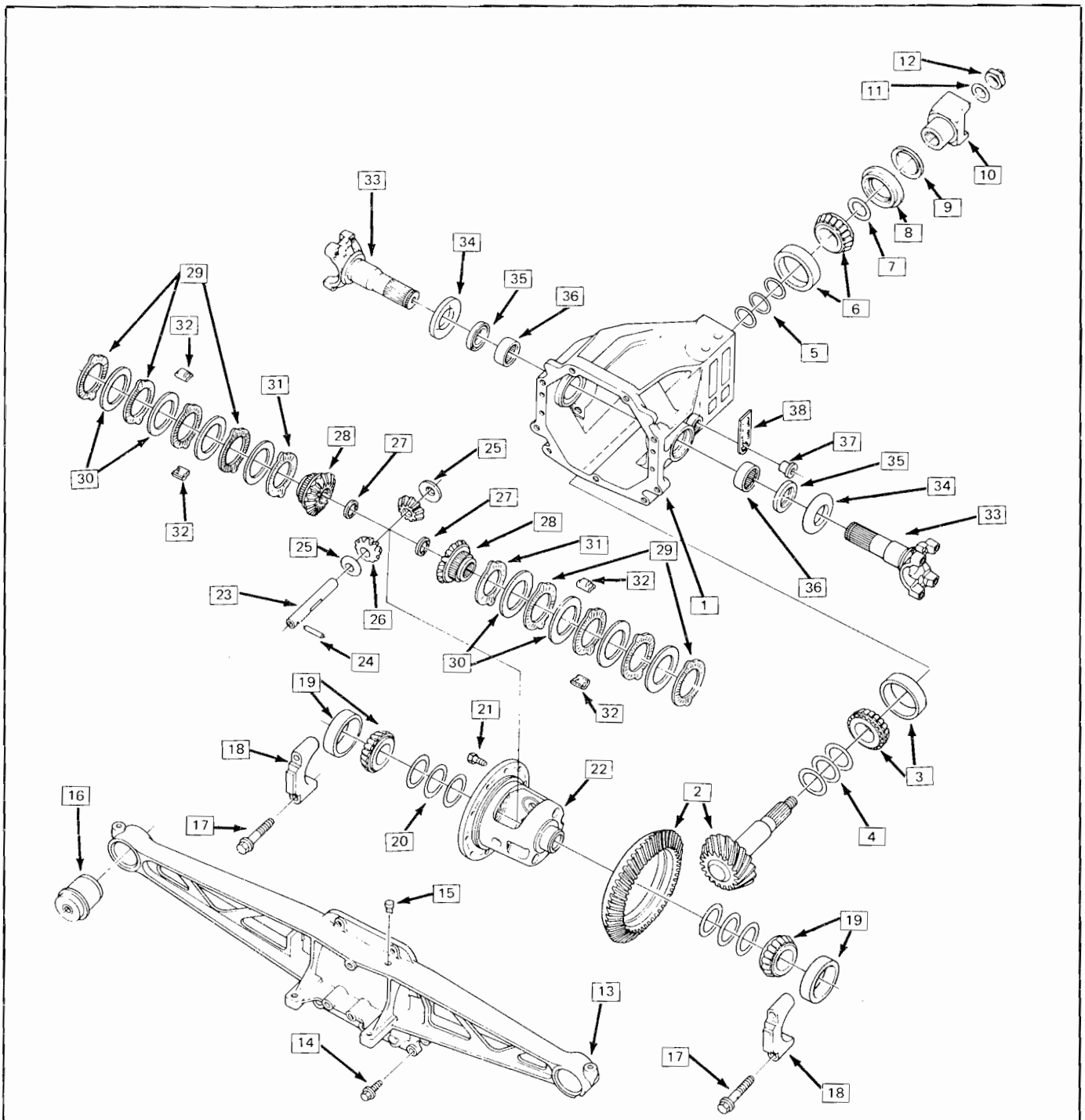
The beam cover is bolted to the carrier and provides accessibility to the internal parts. The filler plug is located on the right side of the differential carrier housing.

DIFFERENTIAL DIAGNOSIS

EXTERNAL NOISES

When a rear axle is suspected of being noisy, it is advisable to make a thorough test to determine whether the noise originates in the tires, road surface, front or rear wheel bearings, engine, transmission, or rear axle assembly. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the rear axle assembly.

Road Noise - Some road surfaces, such as brick or rough-surfaced concrete, cause noise which may be mistaken for tire or rear axle noise. Driving on a different type of road, such as smooth asphalt or dirt, will quickly show whether the road surface is the cause of noise. Road noise usually is the same on drive or coast.



1. CARRIER
2. RING AND PINION GEARS
3. INNER PINION BEARING AND CUP
4. PINION DEPTH SHIMS
5. PINION BEARING PRELOAD SHIMS
6. OUTER PINION BEARING AND CUP
7. OIL SLINGER
8. PINION YOKE SEAL
9. PINION YOKE SEAL DUST SHIELD
10. PINION YOKE
11. WASHER
12. PINION NUT
13. CARRIER COVER BEAM
14. COVER BEAM BOLT
15. VENT
16. BUSHING
17. SIDE BEARING BOLT
18. SIDE BEARING CAP
19. SIDE BEARING AND CUP
20. SIDE BEARING SHIMS
21. RING GEAR BOLT
22. CASE
23. PINION SHAFT
24. PINION SHAFT RETAINER
25. THRUST WASHER
26. PINION GEAR
27. YOKE (AXLE)SHAFT SNAP RING RETAINER
28. SIDE GEAR
29. CLUTCH PACK PLATES
30. CLUTCH PACK DISCS
31. BELLEVILLE SPRING SPACER
32. CLUTCH PACK RETAINER CLIP
33. YOKE (AXLE) SHAFT
34. YOKE (AXLE) SEAL DUST SHIELD
35. YOKE (AXLE) SEAL
36. YOKE (AXLE) BEARING
37. LUBRICANT FILLER PLUG
38. LUBRICANT IDENTIFICATION TAG

Figure 4B-1 Differential Components (Models 36 and 44)

Tire Noise - Tire noise may easily be mistaken for rear axle noise, even though the noisy tires may be located on the front wheels. Tires worn unevenly, or having surfaces on non-skid divisions worn in saw-tooth fashion, are usually noisy and may produce vibrations which seem to originate elsewhere in the vehicle. This is particularly true with low tire pressure.

Test for Tire Noise - Tire noise changes with different road surfaces, but rear axle noise does not. Temporarily inflating all tires to approximately 50 pounds pressure, **for test purposes only** will materially alter noise caused by tires but will not affect noise caused by the rear axle. Rear axle noise usually ceases when coasting at speeds under 30 miles per hour (48 km/h); however, tire noise continues but with lower tone as vehicle speed is reduced. Rear axle noise usually changes when comparing "pull" and "coast", but tire noise remains about the same.

Engine and Transmission Noises - Sometimes a noise which seems to originate in the rear axle is actually caused by the engine or transmission. To determine which unit is actually causing the noise, observe approximate vehicle speeds and conditions under which the noise is most pronounced; then stop vehicle in a quiet place to avoid interfering noises. With transmission in neutral, run engine slowly up and down through engine speeds corresponding to vehicle speed at which the noise was most pronounced. If a similar noise is produced with vehicle standing, it is caused by the engine or transmission and not the rear axle.

Front Wheel Bearing Noise - Loose or rough front wheel bearings will cause noise which may be confused with rear axle noises; however, front wheel bearing noise does not change when comparing "pull" and "coast". Light application of brake, while holding vehicle speed steady, will often cause wheel bearing noise to diminish, as this takes some weight off the bearing. Front wheel bearings may be easily checked for noise by jacking up the wheels and spinning them, and also be shaking wheels to determine if bearings are excessively loose.

Body Boom Noise or Vibration

Objectional "body boom" noise or vibration at 75-100 mph (121-161 km/h) can be caused by an unbalanced propeller shaft. Excessive looseness at the spline can contribute to this unbalance.

Other items that may also contribute to the noise problem are as follows:

1. Undercoating or mud on the shaft, causing unbalance.
2. Shaft balance weights missing.
3. Shaft damage, such as bending, dents, or nicks.
4. Tire-type roughness. Switch tires from a known good vehicle to determine tire fault.

If, after making a comprehensive check of the vehicle, all indications point to the rear axle, further diagnostic steps are necessary to determine the axle components at fault. True axle noises generally fall into two categories: gear noise and bearing noise.

LIMITED SLIP NOISE

Limited Slip differentials have several definite operating characteristics. An understanding of these characteristics is necessary as an aid to diagnosis.

The clutch energizing force comes from the thrust side of the gears and the spring preload from the Belleville spring spacers (Figure 4B-1, Item 32).

Improper operation is generally indicated by clutch slippage or grabbing. Sometimes this produces a chatter or whirring sound. However, these sounds are not always indicative of trouble as they could be produced from a lack of proper lubrication. For example, under certain conditions where one wheel is on a very slippery surface and the other on dry pavement, wheel spin can occur if over acceleration is attempted. Continued spinning may cause audible noise, such as a whirring sound, due to the clutches lacking sufficient lubricant. This does not necessarily indicate failure of the unit.

During regular operation (straight ahead driving) when both wheels rotate at equal speeds, there is an approximately equal driving force delivered to each wheel. When cornering, the inside wheel delivers extra driving force causing slippage in both clutch packs. Consequently, the operational life of the limited slip unit is dependent upon equal rotation of both wheels during straight ahead operation. If wheel rotation for both rear wheels is not equal during straight ahead operation, the positraction unit will constantly be functioning as if the vehicle were cornering. This will impose constant slippage on the clutch packs and will eventually lead to abnormal wear on the clutch pack. Therefore, it is important that there be no excessive differences in the rear wheel tire sizes, air pressures, or tire wear patterns. One indication of this condition is "swerving on acceleration". If swerving on acceleration is encountered, check the rear wheels for different tire size, air pressure, or excessively different wear patterns, and tread depths, before proceeding into an overhaul operation.

LUBRICATION

The forces established when turning a corner tend to apply the clutch packs. For this reason, the use of proper lubricant is very important. The wrong lubricant may cause the clutch surfaces to grab resulting in chatter or noise during a turn. When chatter is encountered, the differential lubricant should be drained and new lubricant should be added.

REAR AXLE NOISES

Figure 4B-2

If a careful test of the vehicle shows that the noise is not caused by external items it is then reasonable to assume that noise is caused by rear axle assembly. The rear axle should be tested on a smooth level road to avoid road noise. It is not advisable to test rear axle for noise by running with rear wheels jacked up.

Noises in the rear axle assembly may be caused by a faulty propeller shaft, faulty rear wheel bearings, faulty differential or pinion shaft bearings, misalignment between two U-joints, or worn

differential side gears and pinions; noises may also be caused by mismatched, improperly adjusted, or scored ring and pinion gear set.

Differential Side Gear and Pinion Noise -Differential side gears and pinions seldom cause noise since their movement is relatively slight on straight ahead driving. Noise produced by these gears will be most pronounced on turns.

Pinion Bearing failures can be distinguished because they rotate at higher speeds than differential side bearings and axle shaft bearings. Rough or brinelled pinion bearings produce a continuous low pitched whirring or scraping noise starting at relatively low speed.

Side Bearings produce a constant rough noise of a lower pitch than pinion bearings. Side bearing noise may also fluctuate in the above wheel bearing test.

GEAR NOISE

There are two basic types of gear noise. The first type is produced by broken, bent, or forcibly damaged gear teeth and is usually quite audible over the entire speed range and presents no particular problem in diagnosis.

For example, hypoid gear tooth scoring generally results from the following: insufficient lubricant, improper breakin, improper lubricant, insufficient gear backlash, improper ring and pinion gear alignment, or loss of drive pinion nut torque. The scoring will progressively lead to complete erosion of the gear tooth, or gear tooth pitting and eventual fracture if the initial scoring condition is not corrected. Another cause of hypoid tooth fracture is extended overloading of the gear set which will produce fatigue fracture, or shock loading which will result in sudden failure.

Differential pinion and side gears rarely give trouble. Common causes of differential failure are shock loading, extended overloading, and seizure of the differential pinions to the cross shaft resulting from excessive wheel spin and consequent lubrication breakdown.

The second type of gear noise pertains to the mesh pattern of the gear teeth. This form of abnormal gear noise can be recognized as it produces a cycling pitch (whine) and will be very pronounced in the speed range at which it occurs, appearing under either "drive", "float" or "coast" conditions. "Drive" is acceleration or heavy pull. "Coast" is with a closed throttle and vehicle in gear and "float" is using just enough throttle to keep the vehicle from driving the engine-vehicle slows down gradually but engine still pulls slightly. Gear noise tends to peak in a narrow speed range or ranges, and will tend to remain constant in pitch. Bearing noise will vary in pitch with vehicle speeds.

CHECKS AND ADJUSTMENTS

Four adjustments are essential for proper operation of the differential and its related parts. These adjustments are a) Pinion Bearing Preload, b) Side Bearing Preload, c) Pinion Depth and d) Ring gear-to-Pinion Backlash.

Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from center is the "heel" end. Toe end of tooth is smaller than heel end (Figure 4B-3).

Adjustments Affecting Tooth Contact

Two adjustments can be made which will affect tooth contact pattern, backlash and position of drive pinion in carrier. The effects of bearing preloads are not readily apparent on (hand loaded) tooth contact pattern tests; however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

Backlash is adjusted by means of the side bearing adjusting shims which moves the entire case and ring gear assembly closer to, or farther from, the drive pinion. (The adjusting shims are also used to set side bearing preload.). The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and inner race of the rear bearing. The shim is used in the rear axle to compensate for manufacturing tolerances. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

Effects of Pinion Position on Tooth Pattern

When the drive pinion is too far away from centerline of the ring gear, the pattern will be a high heel contact on the drive side and high toe contact on coast side (Figure 4B-4). Moving the pinion closer to centerline of the ring gear by increasing shim thickness will cause the high heel contact on drive side to lower and move forward the toe; the high toe contact on coast side will lower and move toward the heel (Figure 4B-4).

When the pinion is too close to the centerline of the ring gear, the pattern will be a low toe contact on drive side, and a low heel contact on the coast side (Figure 4B-4). Moving the pinion farther away from the ring gear by decreasing shim thickness will cause low toe contact on drive side to raise and move toward the heel; the low heel contact on coast side will raise and move toward the toe (Figure 4B-4).

ON-VEHICLE SERVICE

DRIVE SHAFT (AXLE)

Removal (Figures 4B-6 thru 4B-8)

1. Raise vehicle on hoist.
2. Disconnect leaf spring from the knuckle.
3. Disconnect tie rod end from the knuckle.
4. Scribe mark on cam bolt and on mounting bracket so they can be realigned in the same position.
5. Remove cam bolt and separate the spindle support rod from the mounting bracket at the carrier.

A GENERAL DIAGNOSTIC PROCEDURE FOR ISOLATING REAR AXLE NOISE PROBLEMS

	PROBLEM		CAUSE
1.	NOISE IS THE SAME IN DRIVE OR COAST	1.	A) ROAD NOISE B) TIRE NOISE C) FRONT WHEEL BEARING NOISE
2.	NOISE CHANGES ON A DIFFERENT TYPE OF ROAD	2.	A) ROAD NOISE B) TIRE NOISE
3.	NOISE TONE LOWERS AS CAR SPEED IS LOWERED	3.	TIRE NOISE
4.	SIMILAR NOISE IS PRODUCED WITH CAR STANDING AND DRIVING	4.	A) ENGINE NOISE B) TRANSMISSION NOISE
5.	VIBRATION	5.	A) ROUGH REAR WHEEL BEARING B) UNBALANCED OR DAMAGED PROPELLER SHAFT C) TIRE UNBALANCE D) WORN UNIVERSAL JOINT IN PROPELLER SHAFT E) MIS-INDEXED PROPELLER SHAFT AT COMPANION FLANGE F) COMPANION FLANGE RUNOUT TOO GREAT OR LOST BALANCE WEIGHT
6.	A KNOCK OR CLICK APPROXIMATELY EVERY TWO REVOLUTIONS OF REAR WHEEL	6.	A BRINELLED REAR WHEEL BEARING
7.	NOISE MOST PRONOUNCED ON TURNS	7.	DIFFERENTIAL SIDE GEAR AND PINION
8.	A CONTINUOUS LOW PITCH WHIRRING OR SCRAPING NOISE STARTING AT RELATIVELY LOW SPEED	8.	PINION BEARING
9.	DRIVE NOISE, COAST NOISE OR FLOAT NOISE	9.	RING AND PINION GEAR
10.	CLUNK ON ACCELERATION OR DECELERATION	10.	WORN DIFFERENTIAL CROSS SHAFT IN CASE
11.	GRUNT ON STOPS	11.	NO GREASE IN PROPELLER SHAFT SLIP YOKE
12.	GROAN IN FORWARD OR REVERSE	12.	WRONG LUBE IN DIFFERENTIAL
13.	CHATTER ON TURNS	13.	A) WRONG LUBE IN DIFFERENTIAL B) CLUTCH PLATES WORN
14.	CLUNK OR KNOCK ON ROUGH ROAD OPERATION	14.	EXCESSIVE END PLAY OF AXLE SHAFTS TO DIFFERENTIAL CROSS SHAFT

Figure 4B-2 Noise Diagnosis

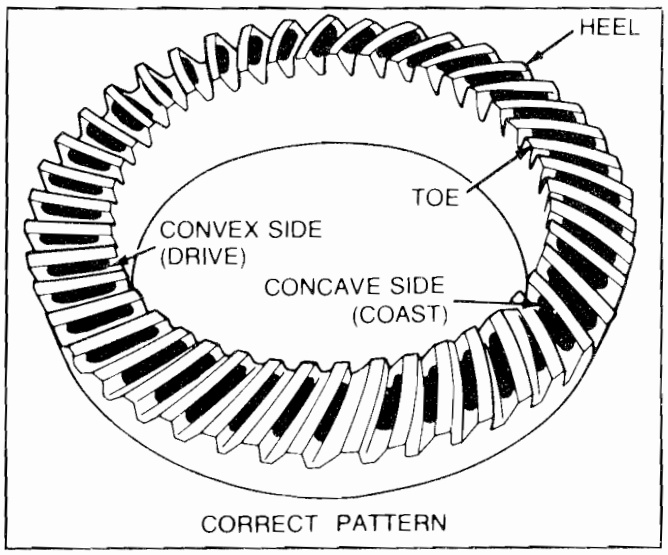


Figure 4B-3 Gear Tooth Nomenclature

6. Remove axle shaft trunnion straps at the spindle and at the side gear yoke.
7. Push out on the wheel and tire assembly and remove the axle shaft.

"U" Joint Replacement

1. Remove bearing cap lock ring from trunnion yoke.
2. Support trunnion yoke on a piece of 1-1/4" pipe on arbor press bed.
3. Using suitable socket or rod, press trunnion down far enough to drive opposite bearing cap from yoke.
4. Remove trunnion and press other bearing cap from yoke, being careful not to drop cap or lose bearing rollers.
5. Remove trunnion and yoke from other joint in a similar manner.
6. Remove dust seals from trunnion, clean and inspect bearing rollers and trunnion.
   Relubricate bearings with a high-melting point wheel bearing type lubricant.

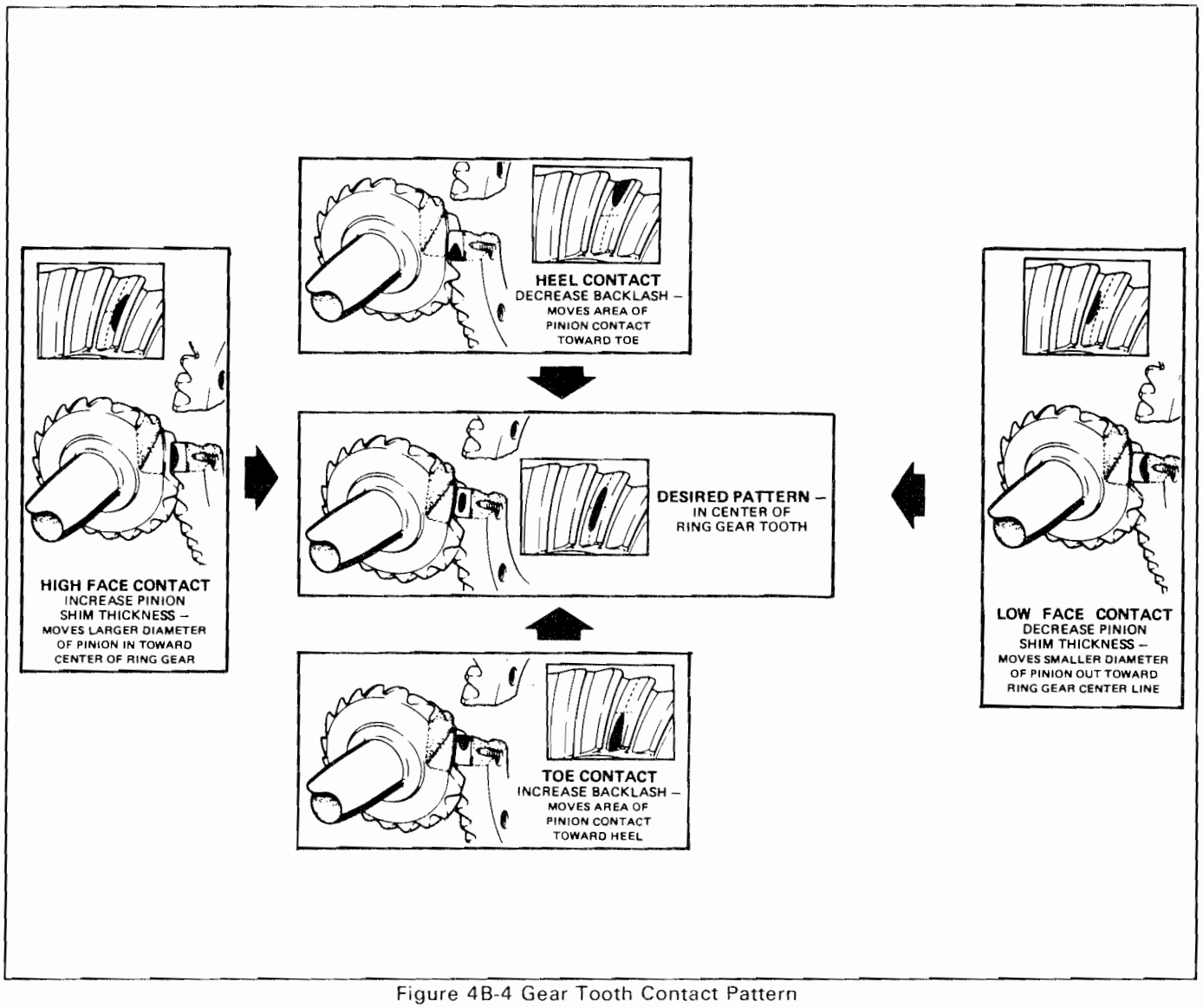
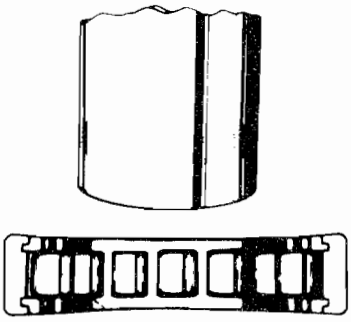


Figure 4B-4 Gear Tooth Contact Pattern

REAR AXLE BEARING DIAGNOSIS

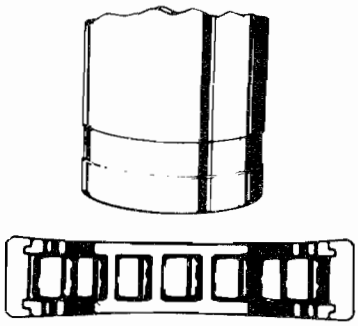


WEAR (MINOR)

LIGHT PATTERN ON RACES AND ROLLERS CAUSED BY FINE ABRASIVES.

CLEAN ALL PARTS AND HOUSINGS. CHECK SEALS AND REPLACE BEARINGS IF ROUGH OR NOISY

REPLACE SHAFT IF DAMAGED

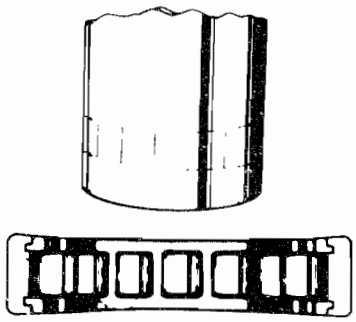


WEAR (MAJOR)

HEAVY PATTERN ON RACES AND ROLLERS CAUSED BY FINE ABRASIVES

CLEAN ALL PARTS AND HOUSINGS. CHECK SEALS AND REPLACE BEARINGS IF ROUGH OR NOISY

REPLACE SHAFT IF DAMAGED

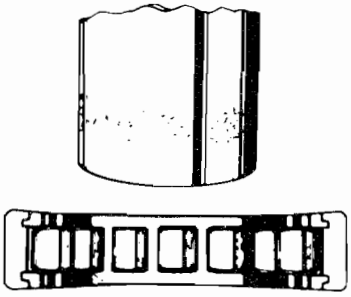


BRINELLING

SURFACE INDENTATIONS IN RACEWAY CAUSED BY ROLL EITHER UNDER IMPACT LOADING OR VIBRATION WHILE THE BEARING IS NOT ROTATING.

REPLACE BEARING IF ROUGH OR NOISY.

REPLACE SHAFT IF DAMAGED

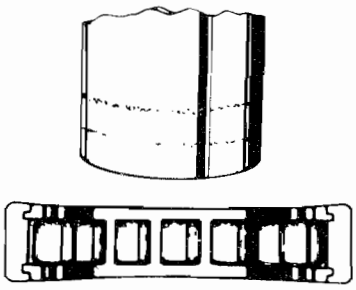


INDENTATIONS

SURFACE DEPRESSIONS ON RACE AND ROLLERS CAUSED BY HARD PARTICLES OF FOREIGN MATERIAL.

CLEAN ALL PARTS AND HOUSINGS CHECK SEALS AND REPLACE BEARINGS IF ROUGH OR NOISY

REPLACE SHAFT IF DAMAGED

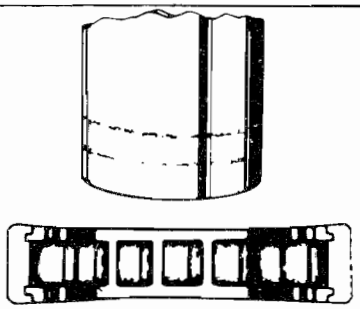


SINGLE EDGE PITTING

FLAKING OF SURFACE METAL RESULTING FROM FATIGUE, USUALLY AT ONE EDGE OF RACE AND ROLLERS

REPLACE BEARING CLEAN ALL RELATED PARTS

REPLACE SHAFT IF DAMAGED

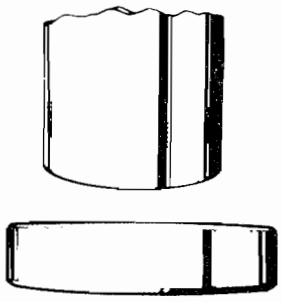


DOUBLE EDGE PITTING

FLAKING OF SURFACE METAL RESULTING FROM FATIGUE, USUALLY AT BOTH EDGES OF RACE AND ROLLERS

REPLACE BEARING -- CLEAN ALL RELATED PARTS.

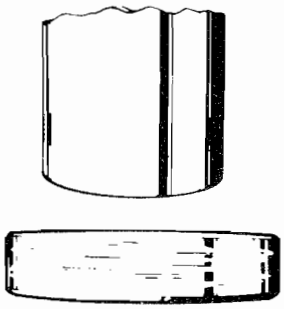
REPLACE SHAFT IF DAMAGED



MISALIGNMENT

REPLACE BEARING AND MAKE SURE RACES ARE PROPERLY SEATED.

REPLACE SHAFT IF BEARING OPERATING SURFACE DAMAGED

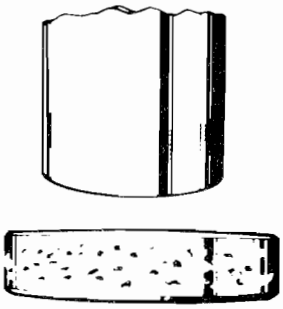


FRETTAGE

CORROSION SET UP BY SMALL RELATIVE MOVEMENT OF PARTS WITH NO LUBRICATION.

REPLACE BEARING, CLEAN RELATED PARTS. CHECK SEALS AND CHECK FOR PROPER FIT AND LUBRICATION.

REPLACE SHAFT IF DAMAGED.



SMEARS

SMEARING OF METAL DUE TO SLIPPAGE. SLIPPAGE CAN BE CAUSED BY POOR FITS, LUBRICATION, OVERHEATING, OVERLOADS OR HANDLING DAMAGE.

REPLACE BEARINGS, CLEAN RELATED PARTS AND CHECK FOR PROPER FITS AND LUBRICATION

Figure 4B-5 Bearing Diagnosis

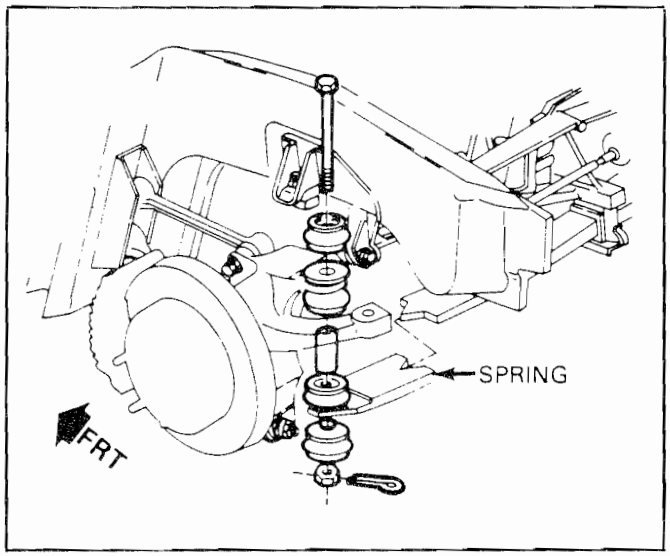


Figure 4B-6 Leaf Spring to Knuckle

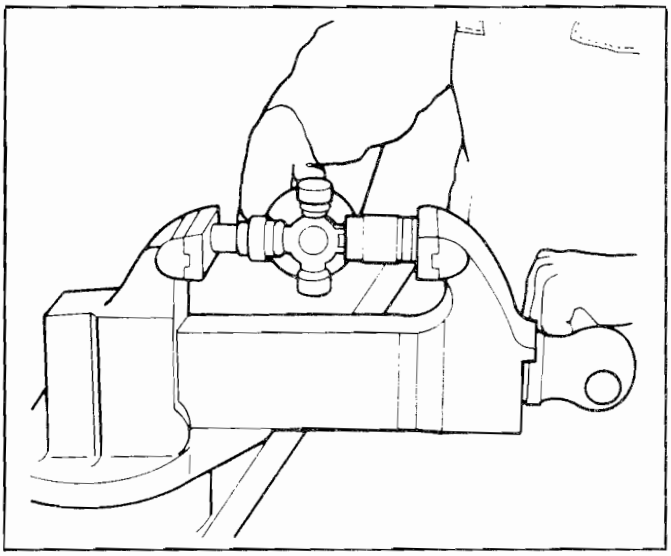


Figure 4B-9 Removing Bearing Cap (Vise)

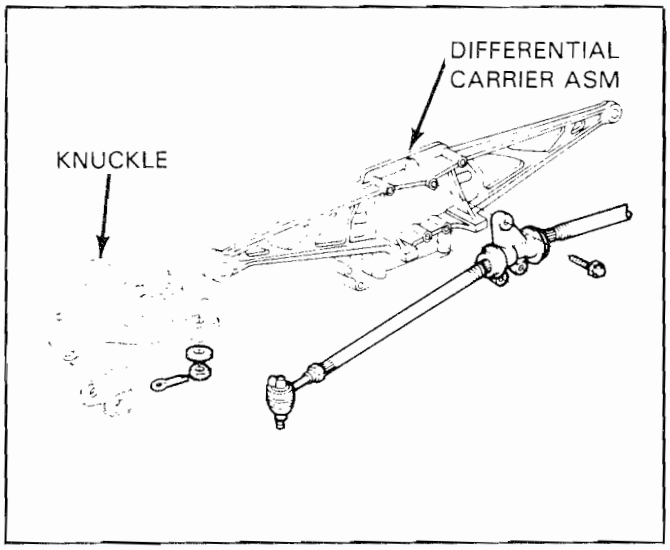


Figure 4B-7 Tie Rod End to Knuckle

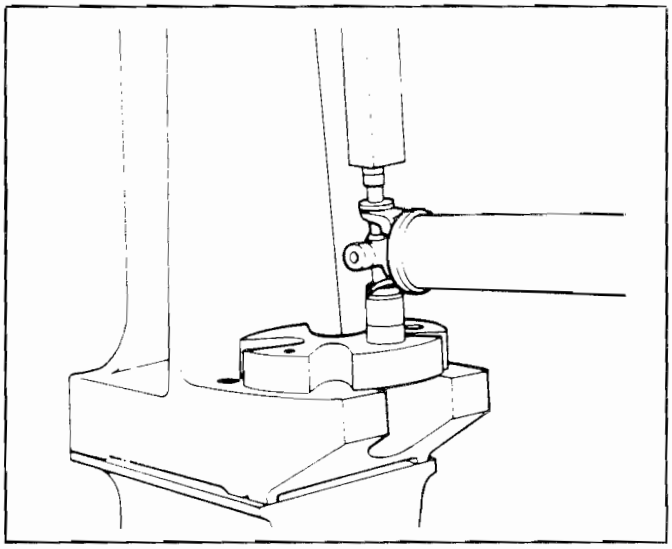


Figure 4B-10 Removing Bearing Cap (Arbor)

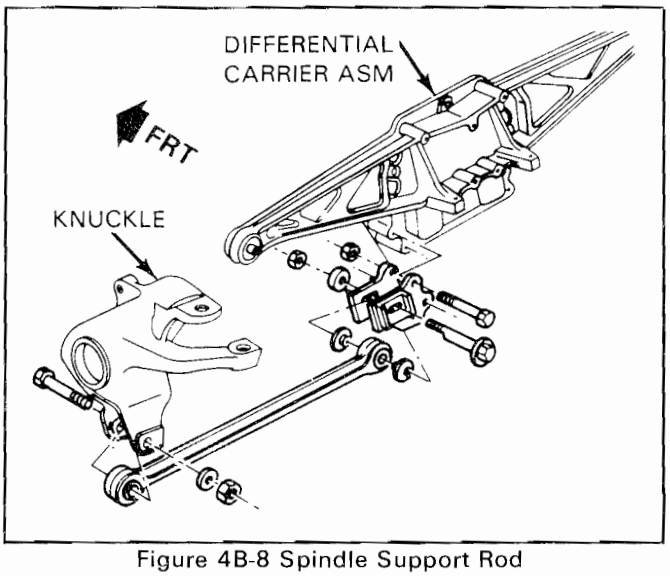


Figure 4B-8 Spindle Support Rod

In addition to packing the bearings, make sure that the lubricant reservoir at the end of each trunnion is completely filled with lubricant. In filling these reservoirs, pack lubricant into the hole so as to fill from the bottom. This will prevent air pockets and ensure an adequate supply of lubricant.

7. Partially install one bearing cap into yoke. Place trunnion in yoke and into bearing cap. Install the other bearing cap and press both bearing caps into yoke, being careful to keep trunnion aligned in bearing caps.
8. Press bearing caps far enough to install lock rings, and install lock rings.

   It may be more convenient to use a bench vise for removal and installation, instead of an arbor press. In this case, proceed with disassembly and assembly procedure as with an arbor press.

Installation

1. Install drive axle shaft trunnion straps and retaining bolts. Torque bolts to 30-40 N·m (22-30 ft. lbs.).
2. Position spindle support rod to bracket and install cam bolt. Align marks on bolt and bracket and torque nut to 215-290 N·m (159-213 ft. lbs.).

3. Position tie rod end in knuckle and install washer and nut. Torque nut to 40-50 N·m (30-36 ft. lbs.) to align slot in nut with hole in stud. Install cotter pin.
4. Position spring to knuckle. Install bolt, insulator, spacer and nut. Tighten nut until slot in nut aligns with hole in bolt and install cotter pin.
5. Lower vehicle.
6. Check and adjust rear suspension alignment as necessary. Refer to Wheel Alignment Section (3A).

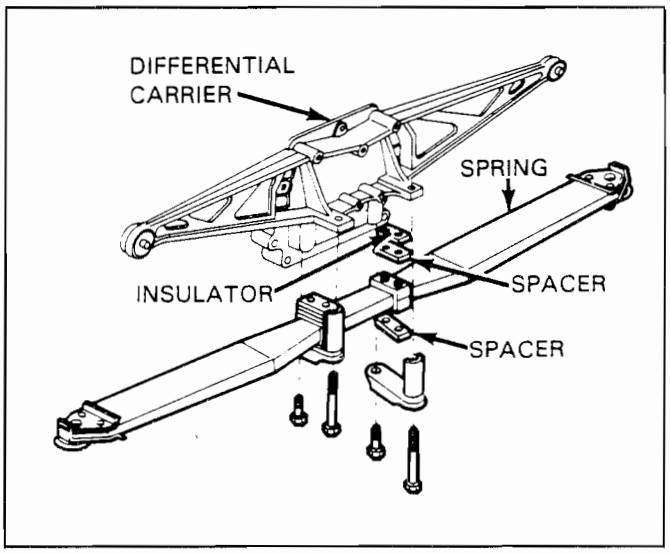


Figure 4B-11 Rear Spring to Diff. Carrier

DIFFERENTIAL CARRIER AND COVER

Removal

1. Remove air cleaner.
2. Disconnect distributor cap from distributor.
3. Raise vehicle.
4. Remove spare tire.
5. Remove spare tire cover by removing support hooks.
6. Remove the upper and lower underbody braces on vehicles equipped with a convertible top.
7. Remove the complete exhaust system as an assembly by:
   a. Disconnect A.I.R. pipe at the converter.
   b. Disconnect A.I.R. pipe clamps at exhaust pipe.
   c. Disconnect oxygen sensor electrical lead.
   d. Remove the exhaust hanger bolts at the driveline support beam.
   e. Remove the bolts attaching the mufflers to the hangers.
   f. Remove hanger bracket at the converter.
   g. Disconnect the exhaust from the exhaust manifold and remove the exhaust system.
8. Disconnect leaf spring at the knuckles and remove attaching bolts at the cover. Remove leaf spring from vehicle.
9. Scribe mark on cam bolts and mounting bracket so they can be realigned in the same position. Remove cam bolts and then mounting bracket from carrier.
10. Disconnect both tie rod ends from the knuckles.
11. Remove the axle shaft trunnion straps from the side gear yokes. Push wheel and tire assemblies outboard to disengage the trunnions from the side gear yokes.
12. Mark relationship of prop shaft to companion flange. Remove prop shaft trunnion straps at pinion flange. Push prop shaft forward into transmission and tie shaft to the driveline support beam.

    Tape bearing cups to trunnion to prevent dropping and/or loss of bearing rollers.
13. Support transmission.
14. Remove differential cover beam attaching bolts at frame brackets.
15. Remove driveline support beam attaching bolts at the front of the differential carrier. Remove differential carrier assembly from the vehicle.

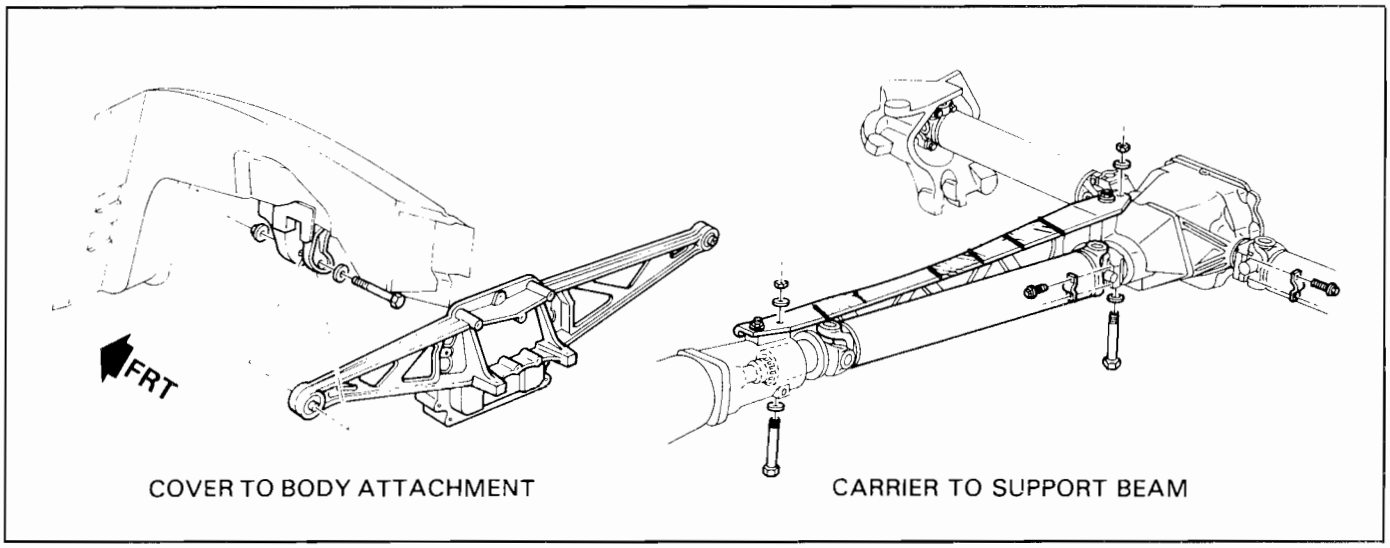


Figure 4B-12 Diff. Carrier Cover Attachments

Installation

1. Reverse removal procedures to install and include the following:
   a. Torque all fasteners to specifications.
   b. Apply sealant GM Part No. 9636067 or equivalent sealant to driveline support beam and differential carrier. Refer to Rear Suspension Section (3D) of this manual.
   c. Fill the rear axle with lubricant. Refer to Maintenance and Lubrication in Section 0B, for correct lubricant usage.
   d. Check and align suspension (if needed). Refer to Wheel Alignment Section (3A) of this manual.
   e. Adjust clearance between top of driveline support beam and tunnel before torquing bolts. Refer to Rear Suspension Section (3D) of this manual.
   f. Refer to the Body Section for upper and lower underbody brace installation and torque specifications.

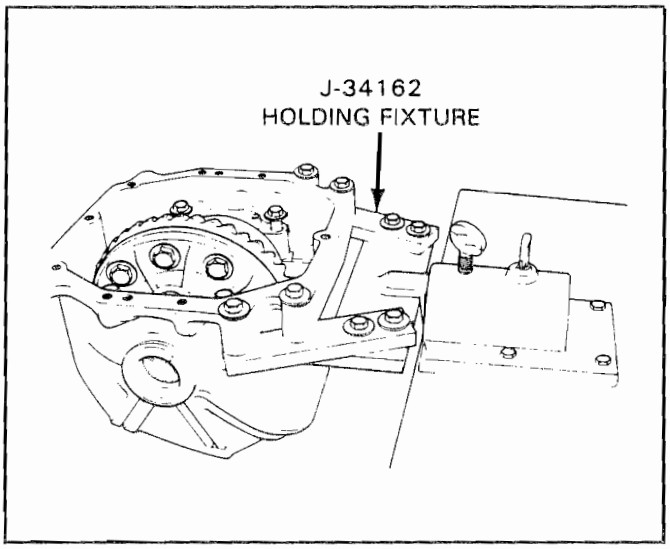
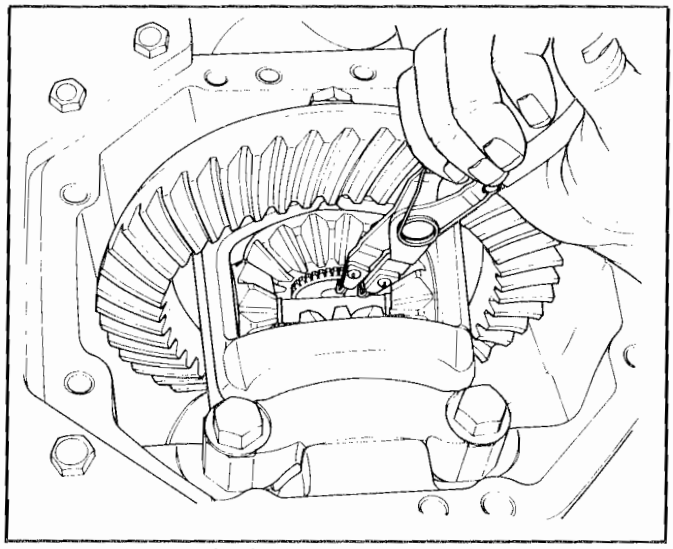
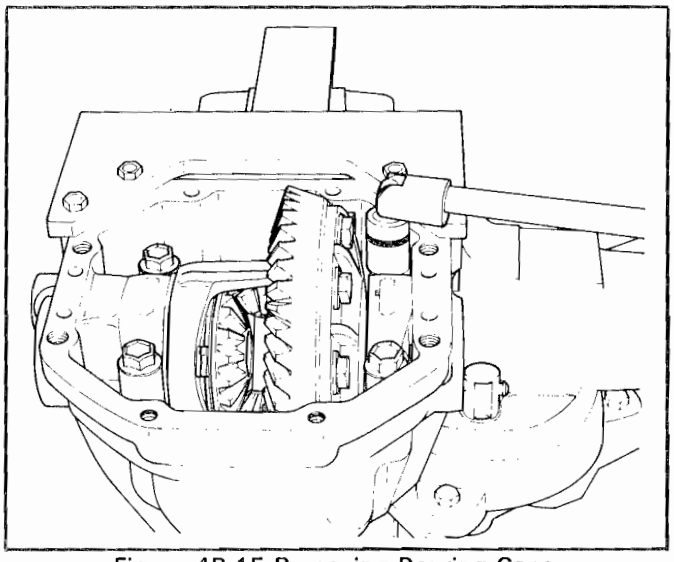


Figure 4B-13 Carrier Mounted on J-34162


Figure 4B-14 Removing Side Yokes


Figure 4B-15 Removing Bearing Caps

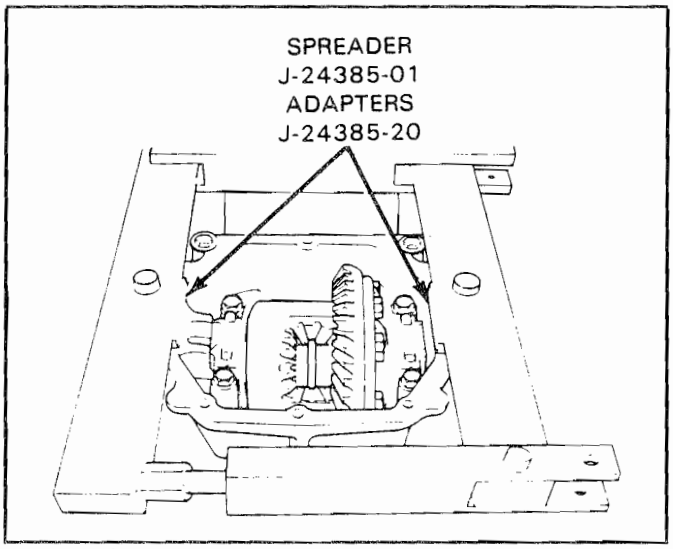


Figure 4B-16 Carrier Spreader Installation (7.875" and 8.5" Axles)

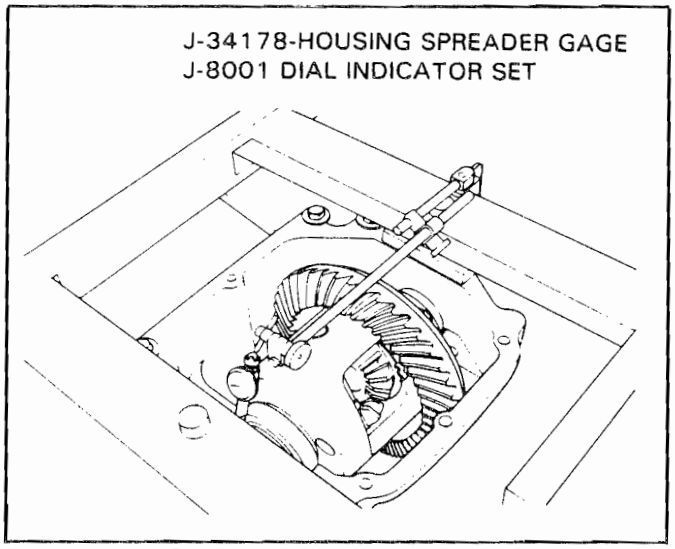


Figure 4B-17 Spreading Carrier (7.875" and 8.5" Axles)

UNIT REPAIR

Differential Case

Removal

1. Remove cover beam attaching bolts, cover and drain lubricant.
2. Bolt carrier to holding fixture J-34162 and then mount J-34162 into base plate J-3389-20 (Figure 4B-13).
3. Remove snap rings that retain yoke shafts in carrier. Remove the yoke shafts (Figure 4B-14). Tag the snap rings to indicate from which side they were removed. The snap rings come in seven sizes and colors for Model 36 (7.875" axle) and eight sizes and colors for Model 44 (8.5" axle). These snap rings control the yoke shaft end play.
4. Remove the bearing caps. Note the matched letters stamped on the caps and carrier. When assembled, the letters on the caps must agree in both the horizontal and vertical position with the letters on the carrier (Figure 4B-15).
5. Mount the spreader J-24385-01 plus adapters J-24385-20 (two J-24385-19's) to the carrier (Figure 4B-16). Using a dial indicator as shown, measure the carrier spread (Figure 4B-17). DO NOT SPREAD CARRIER OVER 0.010" (.25 mm). Remove the indicator.

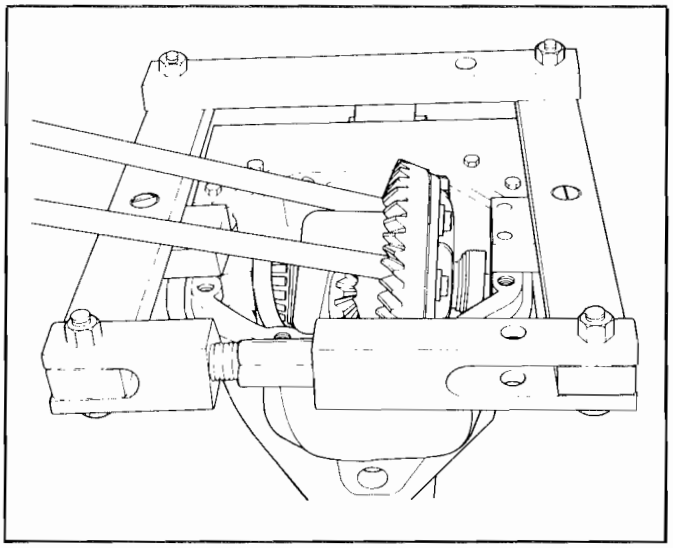


Figure 4B-18 Case Removal

6. Pry the differential case from the carrier with two pry bars (Figure 4B-18). After the differential case has been removed, remove the spreader. Use caution to avoid damage to any machined surface. Mark or tag the bearings cups to indicate from which side they were removed.

Yoke Seal and Bearing

Removal

1. Remove oil seal and bearing assembly using Tool J-34171 (7.875" axle) or Tool J-35509 (8.5" axle), driver handle J-8592 and a hammer. Discard seal and bearing and replace with new ones at time of assembly. Use a standard metal cleaning solvent to clean out the bearing and oil seal bore in the carrier (Figure 4B-19).

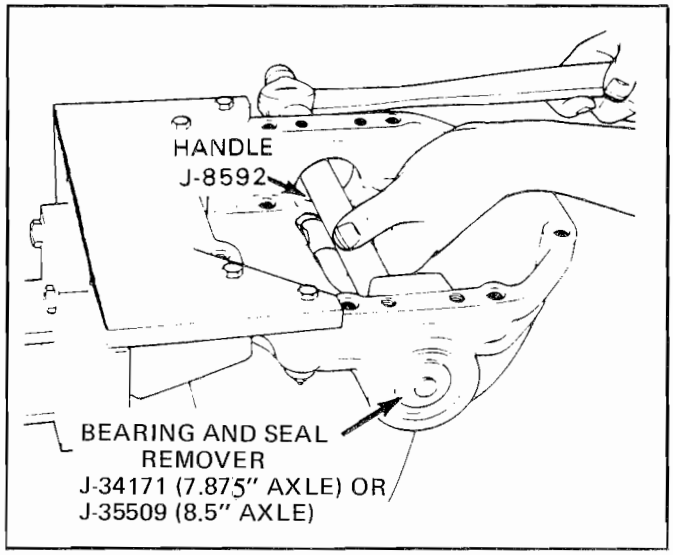


Figure 4B-19 Removing Yoke Seal and Bearing

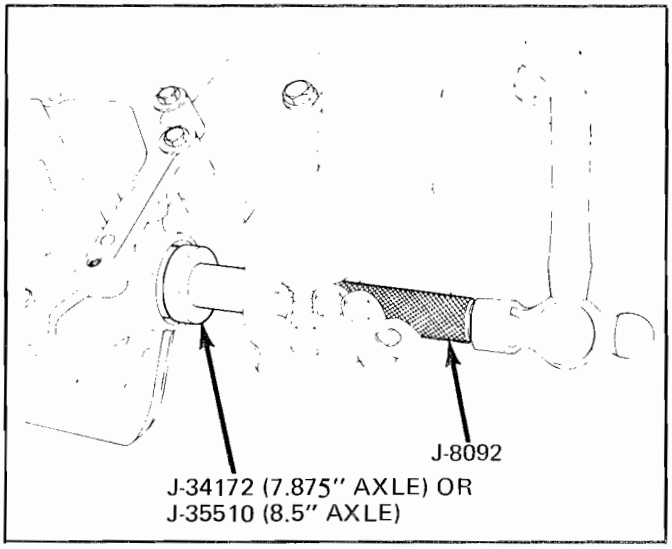


Figure 4B-20 Installing Yoke Bearing

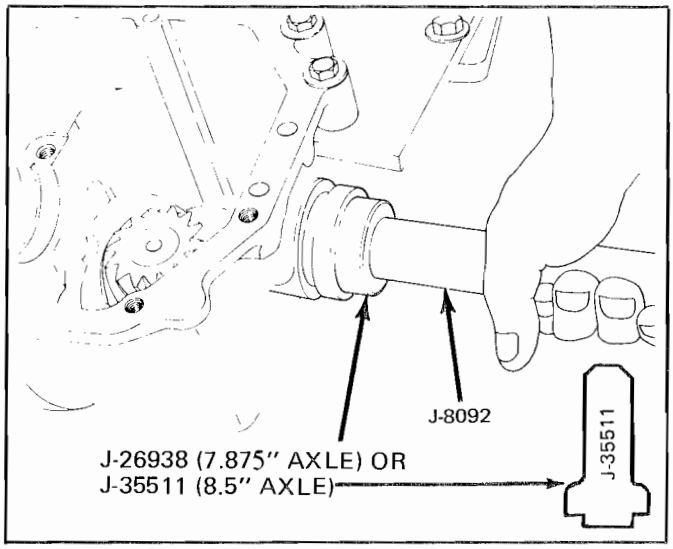


Figure 4B-21 Installing Yoke Seal

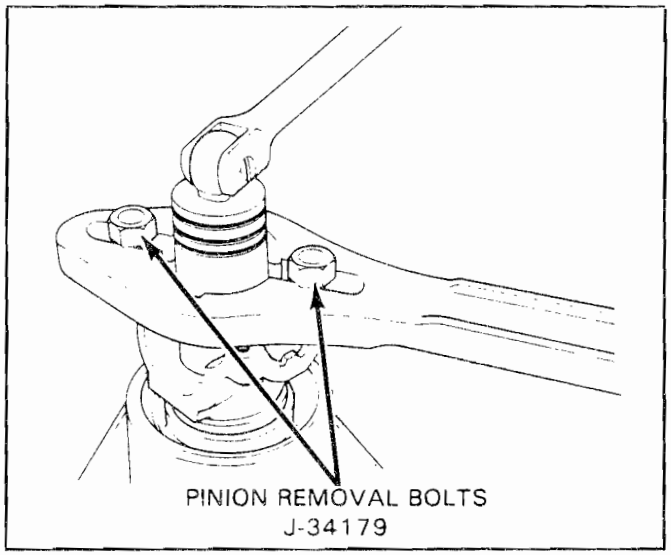


Figure 4B-22 Removing Pinion Flange Nut

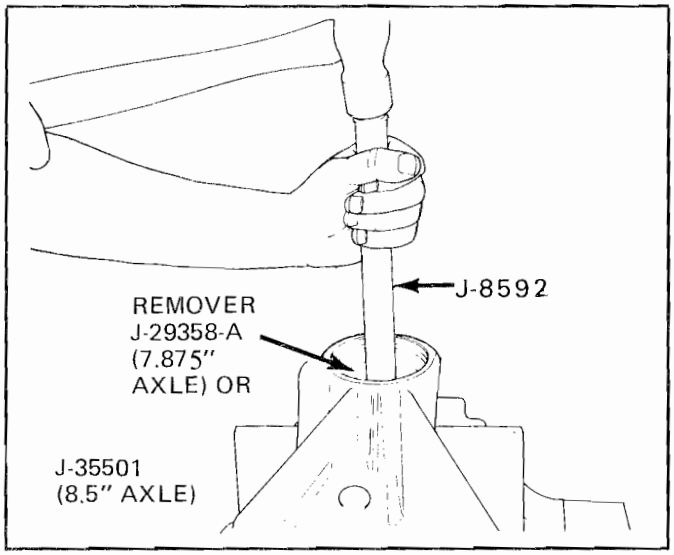


Figure 4B-24 Removing Inner Pinion Bearing Cup

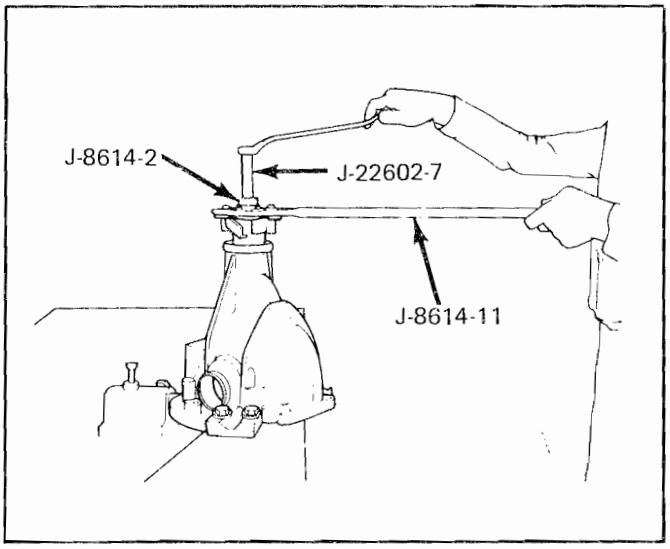


Figure 4B-23 Removing Pinion Flange

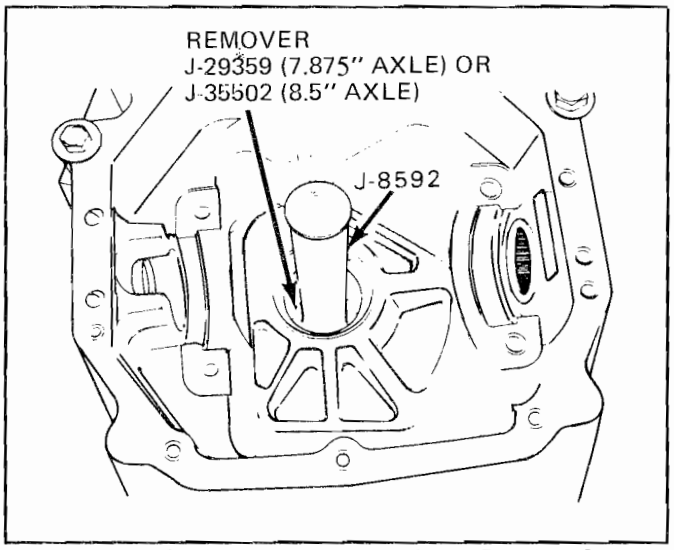


Figure 4B-25 Removing Outer Pinion Bearing Cup

Installation

1. Install new yoke shaft bearing assembly using Tool J-34172 (7.875" axle) or Tool J-35510 (8.5" axle), driver J-8592, and a hammer. Lubricate bearings with hypoid lubricant (Figure 4B-20).
2. Apply a light coat of hypoid lubricant on the lip of the yoke shaft oil seal and install it into the carrier using Tool J-26938 (7.875" axle) or Tool J-35511 (8.5" axle) and driver J-8592 (Figure 4B-21).

Drive Pinion

Removal

1. Hold the end yoke or flange with Tool J-8614-01 and remove the pinion nut and washer (Figure 4B-22).
2. Remove the pinion flange with tools as shown. If the pinion flange shows wear in the area of the seal contact, it should be replaced (Figure 4B-23).
3. Remove the pinion by tapping with a rawhide or heavy duty plastic hammer. Catch the pinion with your hand to prevent it from falling to the floor and being damaged.

On the spline end of the pinion, there are bearing preload shims. These shims may stick to the outer bearing and then fall to the floor. Be sure to collect all these shims and keep them together since they will be used later in assembly. If shims are mutilated, replace with new ones. Shims are available in thicknesses shown in Figure 4B-60.

Pinion Bearings And Oil Seal

Removal

1. Pull out the pinion oil seal with a puller J-23129 and slide hammer J-6125. Discard the seal and replace with a new seal at the time of reassembly. Remove the outer pinion bearing and spacer.
2. Remove the inner pinion bearing cup with Tool J-29358-A (7.875" axle) or Tool J-35501 (8.5" axle) and driver J-8592 as shown. Do not nick carrier bore (Figure 4B-24).
3. Turn the nose of the carrier down. Remove the outer pinion bearing cup using Tool J-29359

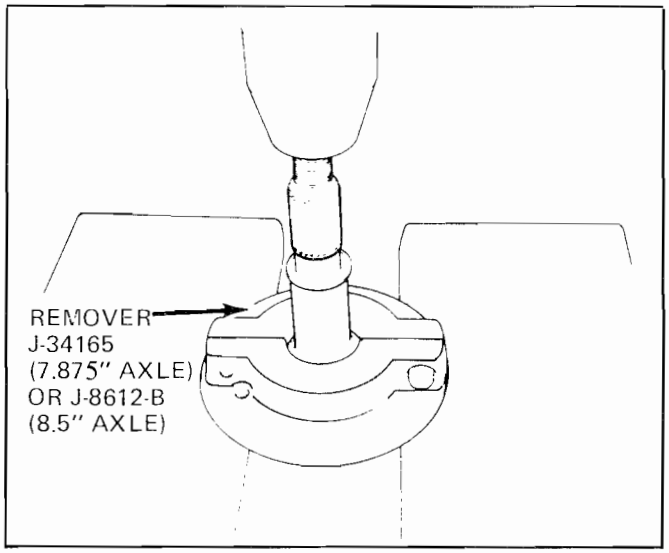


Figure 4B-26 Removing Inner Pinion Bearing

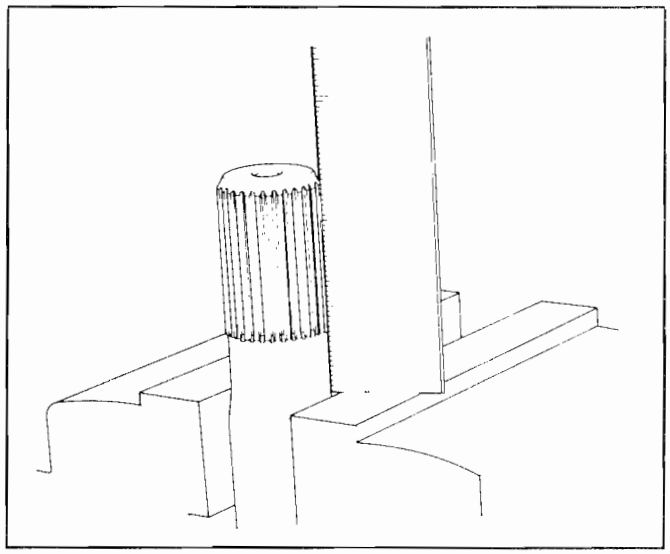


Figure 4B-28 Axle Shaft in Vise

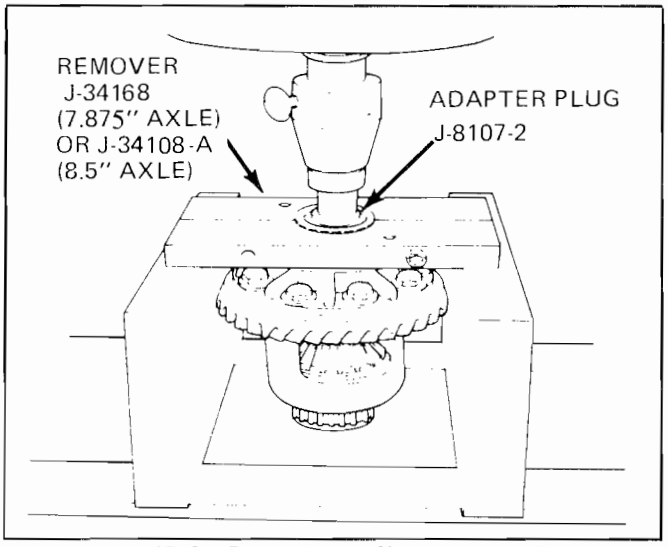


Figure 4B-27 Removing Differential Bearings

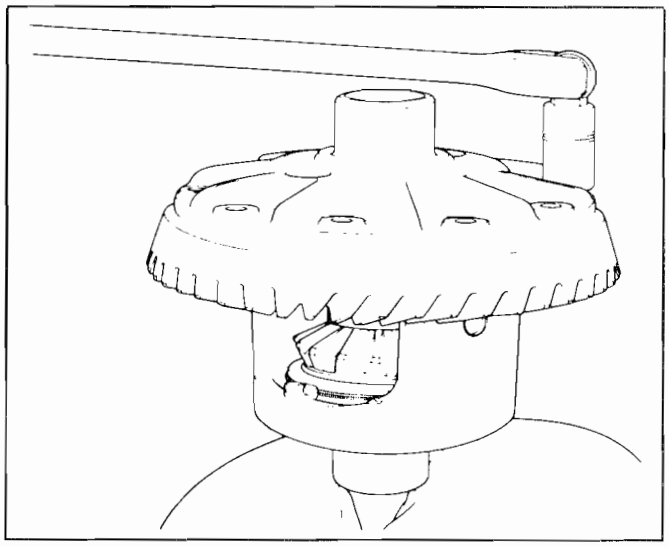


Figure 4B-29 Removing Ring Gear

(7.875" axle) or Tool J-35502 (8.5" axle) and driver J-8592. Do not nick the carrier bore (Figure 4B-25).

4. Remove the inner pinion bearing from pinion with Tool J-34165 (7.875" axle) or Tool J-8612-B (8.5" axle) as shown (Figure 4B-26).

Shims are located between the inner pinion bearing and the pinion head. If the shims are bent or nicked, they should be replaced at time of assembly. Measure each shim individually and wire the shim stack together. If the stack has to be replaced, replace it with the same thickness.

Differential Bearing

Removal

1. Remove the differential bearings with Tool J-34168 (7.875" axle) or Tool J-34108-A (8.5" axle) and adapter plug J-8107-2, as shown (Figure 4B-27).
2. Wire the shims, bearing cup and bearing cone together, and identify from which side they were removed (ring gear side or opposite side). If the shims are mutilated, replace with new ones at time of assembly. Shims are available in thicknesses shown in Figure 4B-60.

It is recommended that whenever bearings are removed, they are (regardless of mileage) to be replaced with new ones.

Ring Gear

Removal

1. Place one of the axle shafts, which was removed from the assembly, into a vise. Tighten the shaft in the vise firmly. The spline end of the shaft is not to exceed 2.750" (69.85 mm) above the top of the vise. This will prevent the shaft from fully entering into the side gear and causing interference with the step plate during disassembly of the pinion gears, etc. Caution should be used that the vise jaws do not locate on the axle splines or any machined surfaces (Figure 4B-28).
2. Place a few shop towels over the vise to prevent any damage during disassembly of the ring gear.

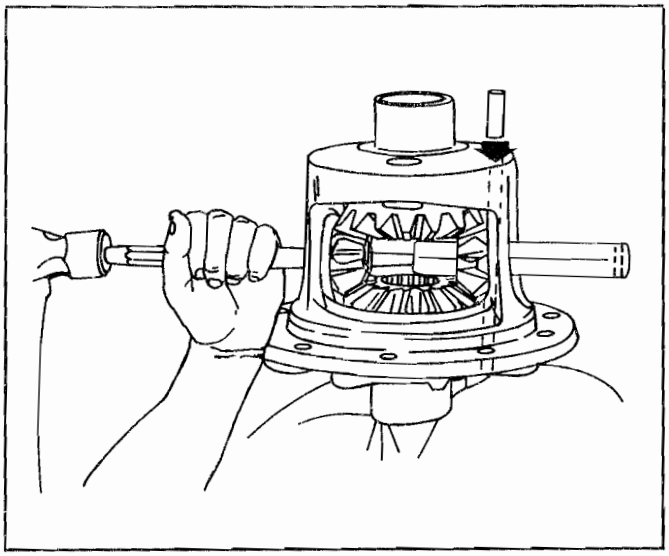


Figure 4B-30 Removing Cross Pin

Assemble the differential on the axle shaft with the ring gear bolt heads up. Assembling the differential onto the shaft will serve as a holding device to remove the ring gear and the internal parts of the case. Remove the ring gear bolts (Figure 4B-29).

3. Remove the ring gear. Tap the ring gear with a rawhide or heavy duty plastic hammer to free it from the case. **WHENEVER THE RING GEAR BOLTS ARE REMOVED, THEY SHOULD BE REPLACED WITH NEW ONES.**
4. Remove the differential case from the axle shaft and remove the ring gear.

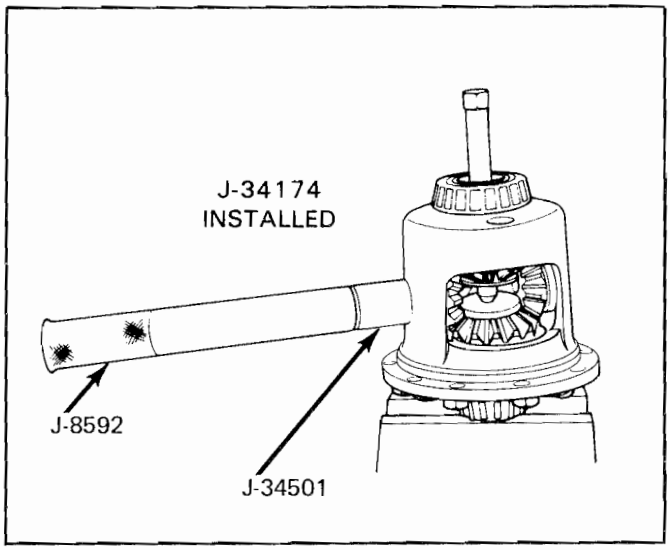


Figure 4B-31 Rotating Gear Using Tool J-34501

Differential Case

Disassembly

1. Reposition the differential case onto the axle shaft. Remove the retaining pin from the cross pin using a punch. Place a shop towel behind the case to prevent the retaining pin from flying out of the case.

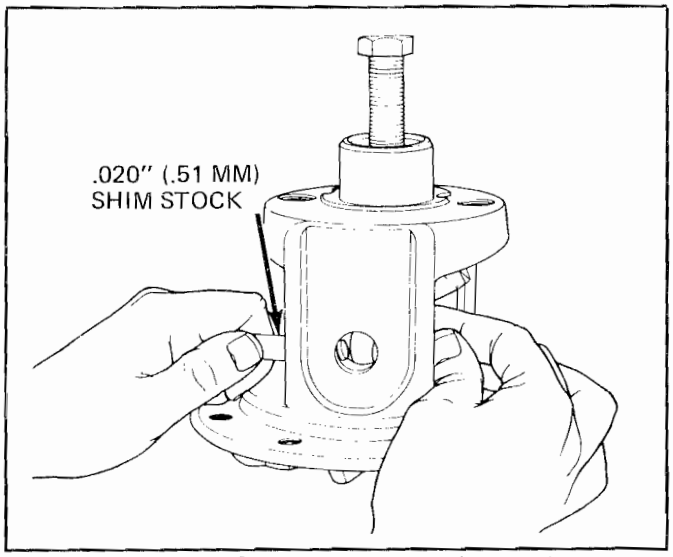


Figure 4B-32 Thrust Washer Removal

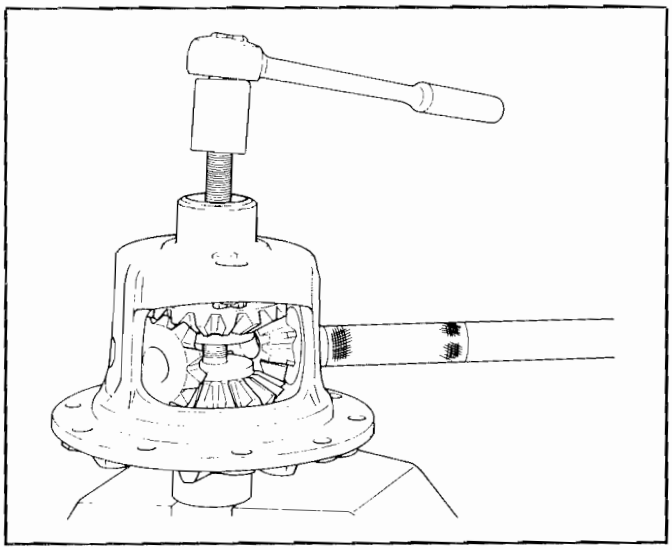


Figure 4B-33 Gear Removal

2. Remove the cross pin. Use a hammer and a punch as shown (Figure 4B-30).
3. Assemble the adapter plate from tool J-34174 into the bottom side gear (Figure 4B-31).
4. Install threaded adapter plate into top side gear (Figure 4B-31). Thread the forcing screws into the threaded adapter until it becomes centered into the bottom adapter plate.
5. Torque the forcing screw until it becomes slightly tight. This will collapse the dished spacers and allow a loose condition between the side gears and pinion gears.
6. Remove both pinion gear spherical washers. Use a shim stock of .020" (.51 mm) thickness or an equivalent tool to push out the spherical washers (Figure 4B-32).
7. Relieve the tension of the dished spacers by loosening the forcing screw.

   It might be necessary to adjust the forcing screw slightly to allow the case to rotate.
8. Assemble turning adapter Tool J-34501 onto handle J-8592. Insert into the cross pin hole of the

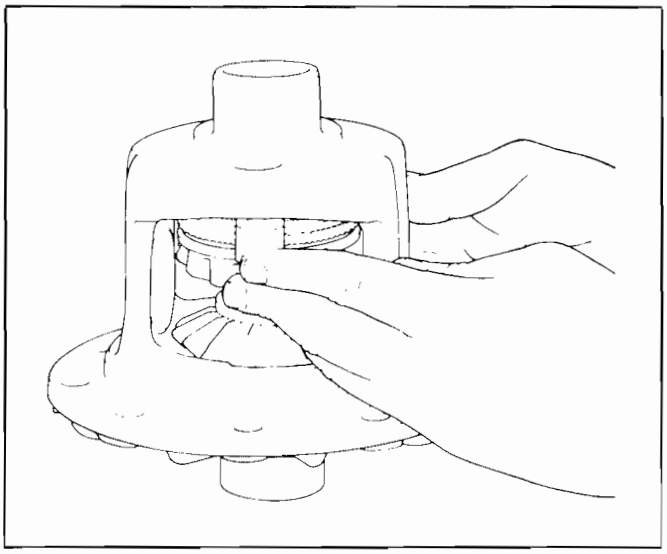


Figure 4B-34 Remove Clutch Pack

case. Pull on the handle and rotate the case until the pinion gears can be removed. Remove gears (Figure 4B-33).

9. Hold the top clutch pack with one hand and remove the tools.
10. Remove the top side gear and clutch pack. Keep the stack of plates and discs intact in exactly the same position while they are being removed (Figure 4B-34).
11. Remove the case from the axle shaft. Turn the case with the flange or ring gear side up and allow the adapter plate, side gear and clutch pack to be removed from the case. Remove the retainer clips from both clutch packs to allow separation of the plates and discs. Keep the stack of plates and discs exactly as they were removed (Figure 4B-35).

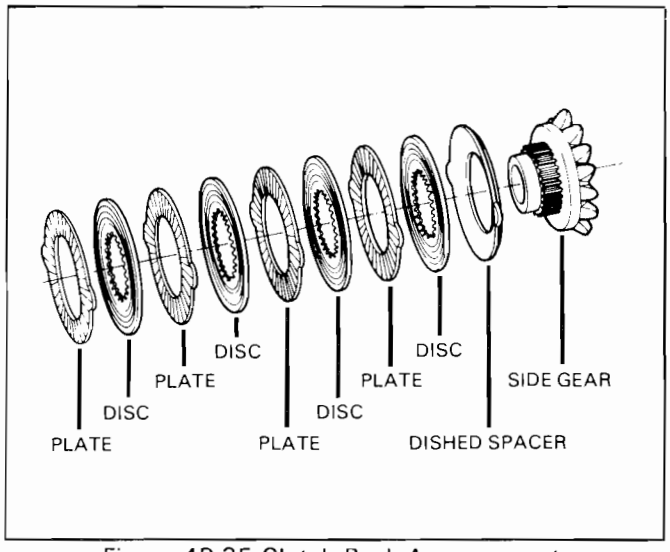


Figure 4B-35 Clutch Pack Arrangement

INSPECTION OF ALL PARTS FOR WEAR, SCORE, ETC.

Plates and Discs - If any one member of either stack shows evidence of excessive wear or scoring, the complete stack is to be replaced on both sides.

Side Gears and Pinion Mate Gears - The gear teeth of these parts should be checked for extreme wear and possible cracks. The external teeth of the side gear, which retain the concentric groove discs, should also be checked for wear or cracks.

If replacement of one gear is required due to wear, etc., then both side gears, pinion gears, and washers are to be replaced.

Cross Pin - If excessive wear is evident, the cross pin should be replaced.

Clutch Retainer Clips - If wear is evident on any one of the retainer clips, all four clips must be replaced.

Differential Case - If scoring, wear or metal pickup is evident on the machined surfaces, then replacement of the case is necessary.

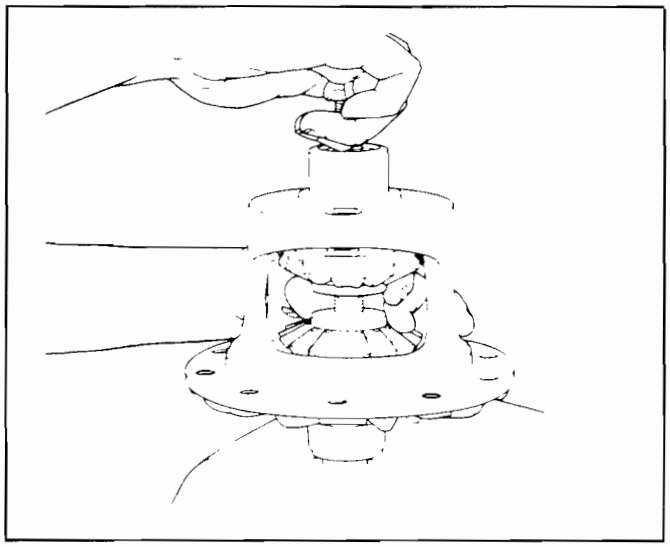


Figure 4B-36 Installing Adapter Plate

Differential Case

Reassembly

1. Prelubricate the thrust face of the side gears, and the plates and discs with the proper limited slip rear axle lube.
2. Assemble the plates and discs in exactly the same position as they were removed, regardless of whether they are new parts or the original parts. Be sure the lubricant that is used is of the specified type (Figure 4B-35).
3. Assemble the retainer clips to the ears of the plates. Make sure both clips are completely assembled or seated onto the ears of the plates.

Assemble the clutch pack and side gear into the top side gear bore. Make sure the clutch pack stays assembled to the side gear splines, and that the retainer clips are completely seated into the pockets of the case. To prevent pack from falling out of the case, it will be necessary to hold them in place by hand while repositioning the case on bench.

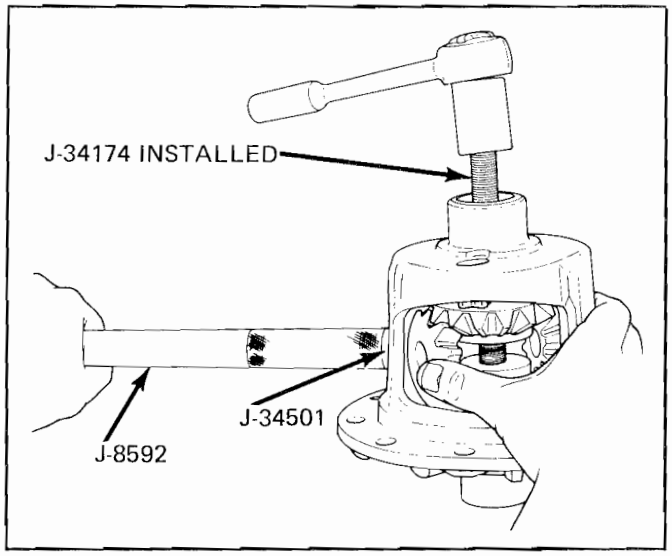


Figure 4B-37 Pinion Gear Installation

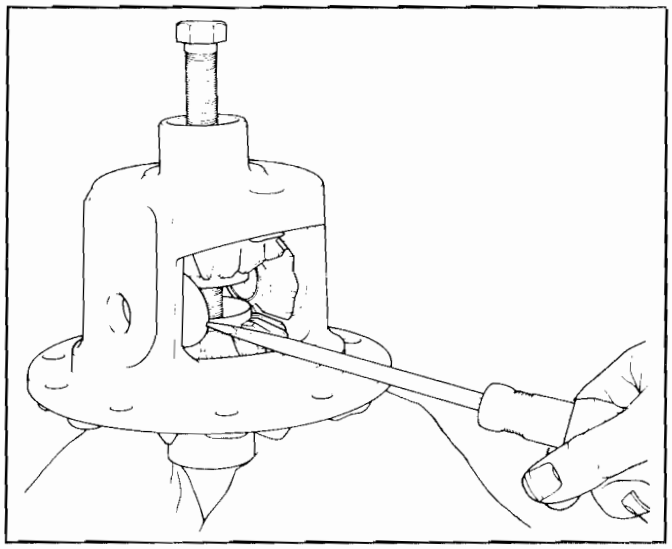


Figure 4B-38 Thrust Washer Installation

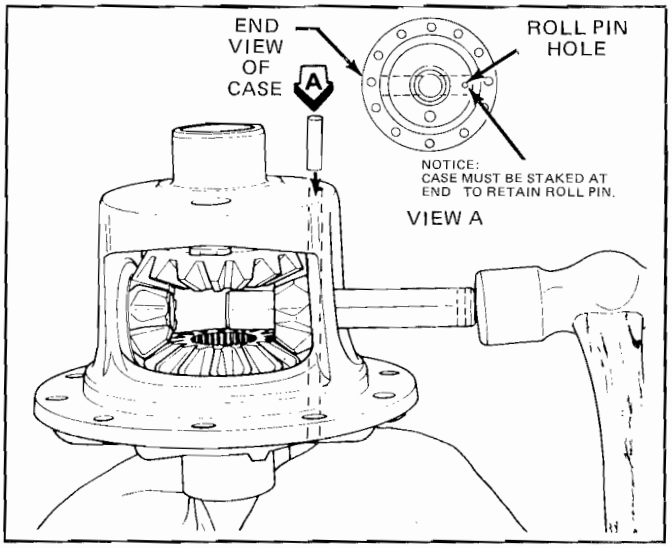


Figure 4B-39 Installing Cross Pin

4. Position the adapter plate from Tool J-34174 onto the side gear.
5. Assemble the other clutch pack and side gear. Make sure the clutch pack stays assembled to the side gear splines, and that the retainer clips are completely seated into the pockets of the case.

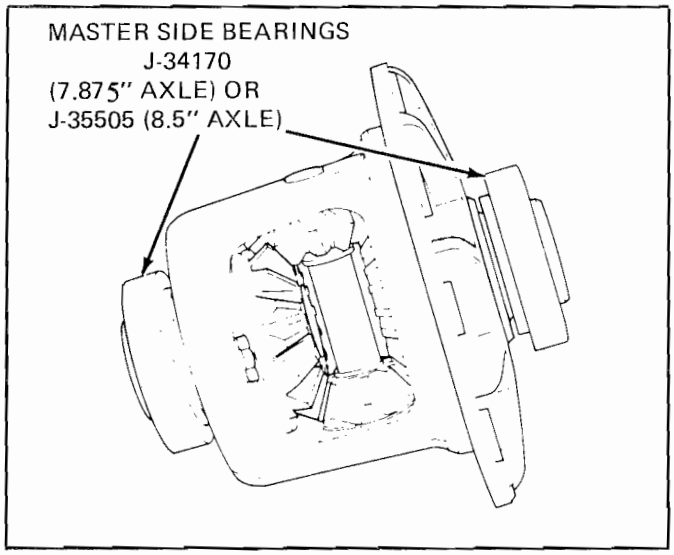


Figure 4B-40 Installing Master Bearings

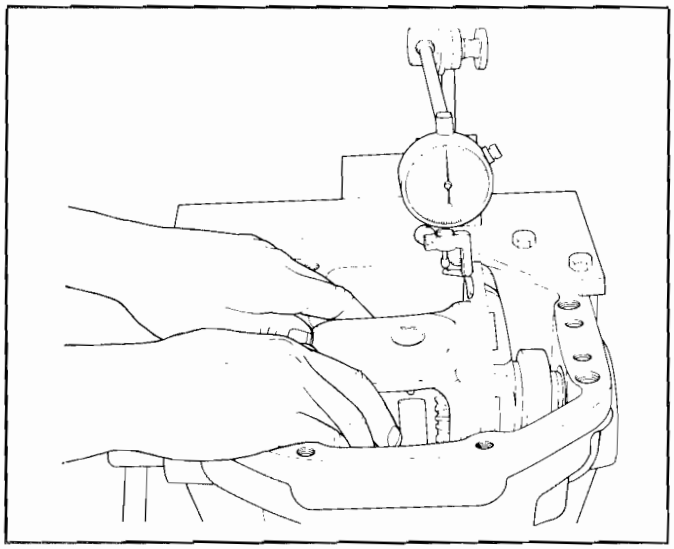


Figure 4B-41 Reading The Indicator

6. Hold the clutch pack in position and insert tool J-34174 (Figure 4B-36). Tighten the forcing screw into the bottom adapter. This will hold both clutch packs in position.
   With tools assembled into the case, position case onto the axle shaft by aligning the splines of the side gear with those of the shaft.
7. Tighten the forcing screw to compress clutch packs in order to provide clearance for pinion gears. Insert pinion gears (Figure 4B-37).
8. While holding the gears in place, insert Tool J-34501 with handle J-8592 in the cross pin hole of the case. Pull on the handle and rotate the case allowing the gears to turn. Make sure that the holes of the pinion gears are in alignment with holes of the case.
   It may be necessary to adjust the tension on the forcing screw to rotate the case.

9. Prelubricate the spherical washers. Assemble the spherical washers into case. Use a small screwdriver to push the washers into place (Figure 4B-38). Remove the tools.
10. Position the cross pin shaft in the case and drive in with a hammer. Be sure the retaining pin hole of the cross pin shaft is properly aligned to allow installation of the retaining pin. Install the retaining pin to the proper depth using a punch and stake in place at both ends of the case (Figure 4B-39).

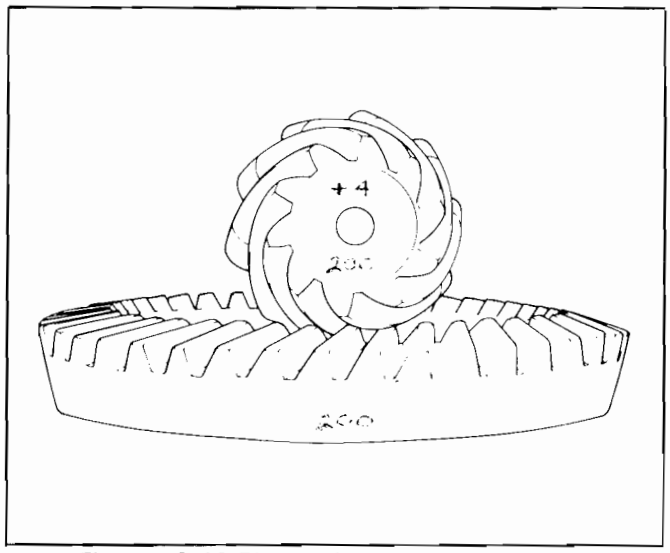


Figure 4B-42 Ring and Pinion Identification

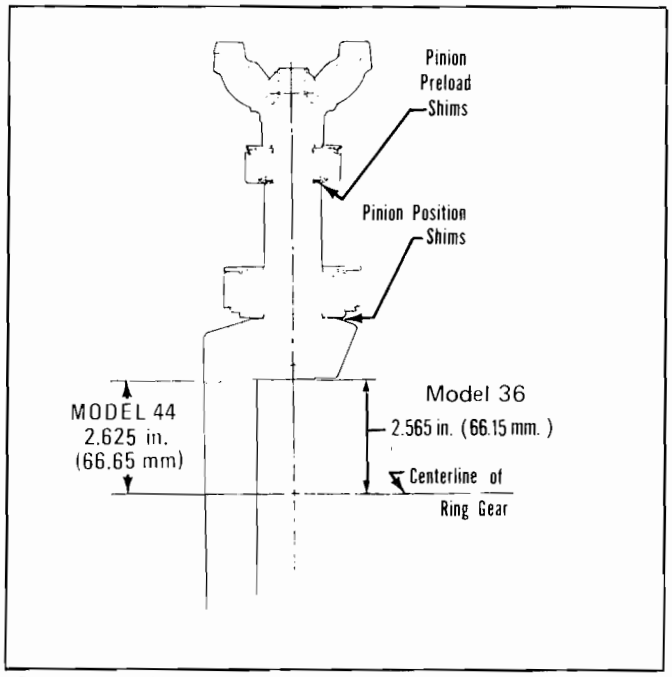


Figure 4B-43 Pinion Depth and Preload Shims (7.875" and 8.5"Axles)

Differential Case

Installation and Adjustment

1. Install the master differential bearings J-34170 (7.875" axle) or J-35505 (8.5" axle) onto the case. Remove all nicks, burrs, dirt, etc., from the hubs to allow the master bearings to rotate freely (Figure 4B-40).
2. Assemble the differential case into the carrier (less pinion). Mount a dial indicator to the supporting fixture and indicate on the flange face as shown (Figure 4B-41). Locate the tip of the indicator on the machined surface of the flange face. Force the differential assembly as far as possible in the direction towards the indicator. With force still applied, set indicator at zero (Figure 4B-41). Indicator should be capable of a minimum of .200" (5.06 mm) travel.
3. Force the differential assembly as far as it will go in the opposite direction. Repeat these steps until the same reading is obtained.

   Record the reading of the indicator. This amount, in shims, will be included in the final assembly shim stacks to establish differential bearing preload and ring gear backlash.

   After making sure the readings are correct, remove the indicator and differential assembly from the carrier.

Setting Pinion Depth

Figure 4B-45

Ring gear and pinions are supplied in matched sets only. Matching numbers on both pinion and ring gear are etched for verification. If a new gear set is being used, verify the numbers on each pinion and ring gear before proceeding with the assembly.

The distance from the centerline of the ring gear to one button end of the pinion is 2.565 inches (65.15 mm) for the 7.875" axle and 2.625 inches (66.65mm) for the 8.5" axle.

On the button end of each pinion there is etched a plus (+) number, a minus (-) number, or a zero (0), which indicates the best running position for each particular gear set. The position of the pinion is controlled by the amount of shims between the inner pinion bearing and the pinion head. (Figure 4B-43).

For example - if a pinion is etched +3 (m+8), this pinion would require .003" (.08 mm) less shims than a pinion etched "0". This means that by removing shims, the mounting distance of the pinion is increased to 2.568" (65.23 mm) for the 7.875" axle and 2.628" (66.73mm) for the 8.5" axle. which is just what a +3 (m+8) indicates. Or if a pinion is etched -3 (m-8), we would want to add .003" (.08 mm) more shims than would be required by a pinion that is etched "0". By adding .003" (.08 mm) shims the mounting distance of the pinion was decreased to 2.562" (65.07 mm) for the 7.875" axle and 2.622" (66.57 mm) for the 8.5" axle, which is just what a -3 (m-8) etching indicates.

If the old ring and pinion set is to be reused, measure the old shim stack and build a new shim stack to this same dimension. It is recommended that each shim be measured individually and then added together to obtain the shim stack total. To change the pinion position, shims are available in thicknesses shown in Figure 4B-60.

If a new gear set is used, notice the plus (+), minus (-) or zero (0) etching on both the old and new pinion and adjust the thickness of the new shim pack

Old Pinion Marking	New Pinion Marking								
	-4	-3	-2	-1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003
0	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004
-1	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005
-2	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006
-3	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007
-4	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007	-0.008

Figure 4B-44 Shim Change Chart (7.875" and 8.5" Axles)

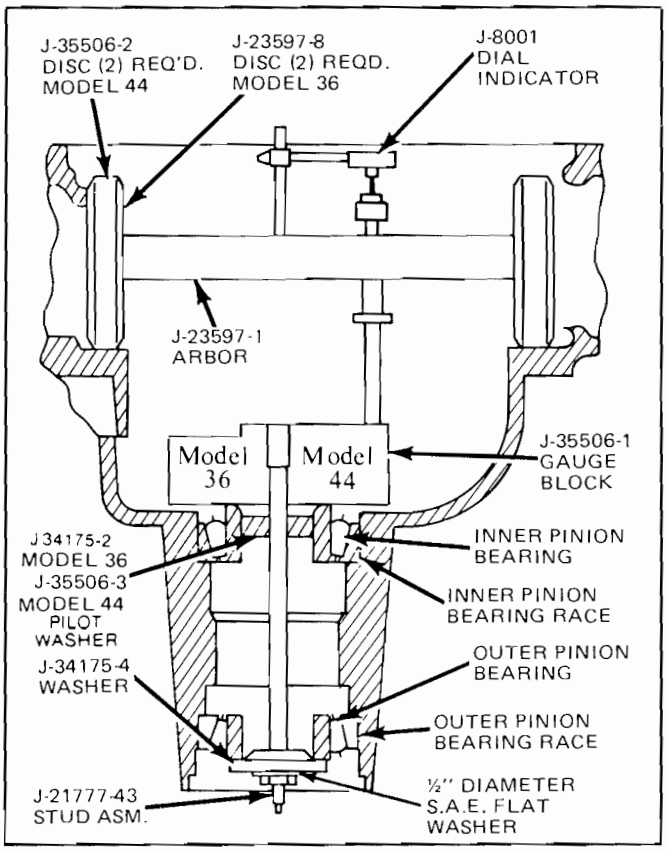


Figure 4B-45 Pinion Depth Gage Assembly (7.875" and 8.5" Axles)

to compensate for the difference between these two pinion etchings. The chart in Figure 4B-44 is helpful for determining this change.

For example: If the old pinion is etched +2 (m+5) and the new pinion is etched -2 (m-5), then add .004" (.10 mm) to the original shim stack thickness in order to install the new pinion at proper position.

Pinion Gear Depth Adjustment

Be sure that all carrier bores are free from all nicks, dirt or any other contamination.

1. Make certain all gage tools and carrier parts are clean.
2. Install inner pinion bearing cup using Tool J-7818 (7.875" axle) or J-8608 (8.5" axle).
3. Install outer bearing cup using Tool J-7817 (7.875" axle) or J-8611-01 (8.5" axle).
4. Lubricate pinion bearings liberally with specified gear lubricant.
5. Install pinion gage assembly as shown in Figure 4B-45. Use the same pinion bearings that will be used in final assembly.
6. Torque the nut on the pinion gage assembly until it requires 10 in. lbs. (1.13 N·m) to rotate the assembly. Rotate the assembly several revolutions to seat the bearing and recheck the torque required to rotate the pinion gage assembly.
7. Place J-23597-8 (7.875" axle) or J-35506-2 (8.5" axle) Side Bearing Discs onto the J-23597-1 Arbor and install the assembly into the carrier as shown in Figure 4B-45. Tap discs lightly with plastic hammer to seat. Tighten the side bearing caps onto the discs until slight resistance is felt when rotating the arbor.
8. Position the gage plunger onto the proper gaging step of the gage block for the axle being serviced (Model 36 step for 7.875" axle or Model 44 step for 8.5" axle). Install J-8001 Dial Indicator to the arbor post. Push the dial indicator downward until the needle rotates approximately 3/4 turn clockwise. Tighten the dial indicator in this position and recheck.
9. Rotate the gage shaft slowly back and forth until the dial indicator reads the greatest deflection. At the point of greatest deflection, set the dial indicator to zero. Repeat the rocking action of the gage shaft to verify the gage setting.
10. After the zero setting is obtained, rotate the gage shaft until the dial indicator plunger does not touch the gage block.
11. Record the dial indicator reading. Example: If the pointer moved counterclockwise .067" to a

dial reading of .033", this indicates a shim thickness of .033".

12. This reading indicates the shim thickness that is required for a pinion that is etched with a zero (0) on the pinion head. If the pinion being installed has a plus(+) or minus (-) etching, then an adjustment of the shim thickness is required.
    Example: If a pinion is etched "+3", then .003" less shim thickness is required. Subtract .003 from the indicator reading. If a pinion is etched "-3", then .003" more shim thickness is required. Add .003 to the indicator reading.
13. Remove the special gaging tools. Measure each shim separately with a micrometer and add together to get the total required shim stack thickness.

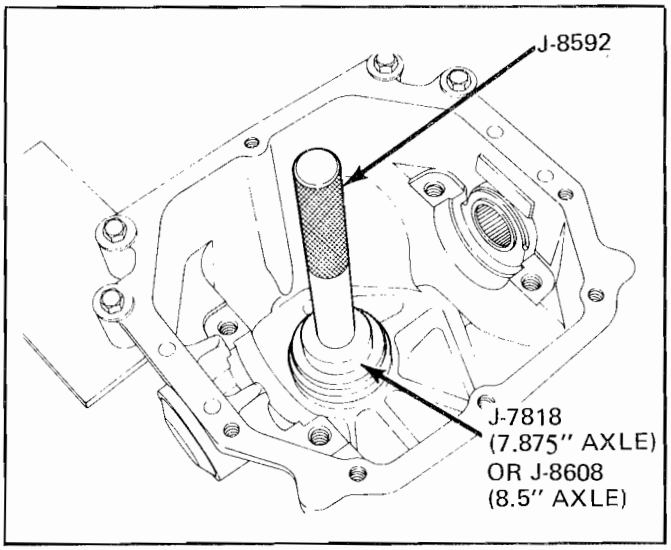


Figure 4B-46 Installing Inner Pinion Bearing Cup

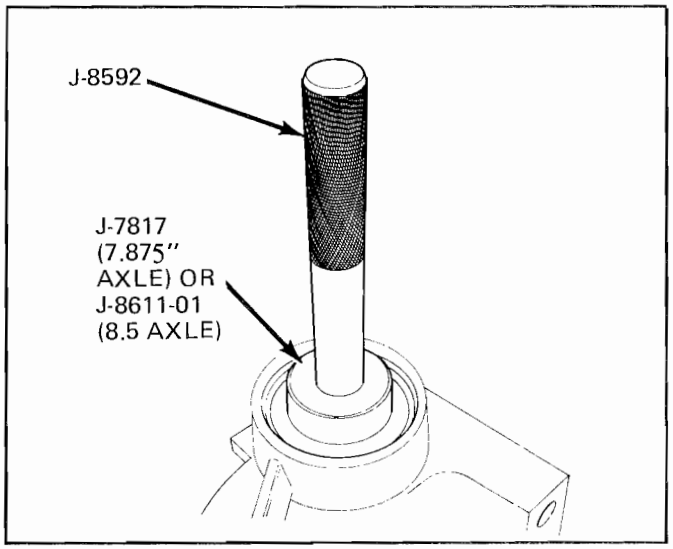


Figure 4B-47 Installing Outer Pinion Bearing Cup

14. Assemble the shims and the inner pinion bearing on the pinion. Place bearing installer J-5590 (7.875" axle) or J-35512 (8.5" axle) over pinion shaft and drive the bearing and shims on the shaft until they are completely seated against the thrust face of pinion (Figure 4B-48).

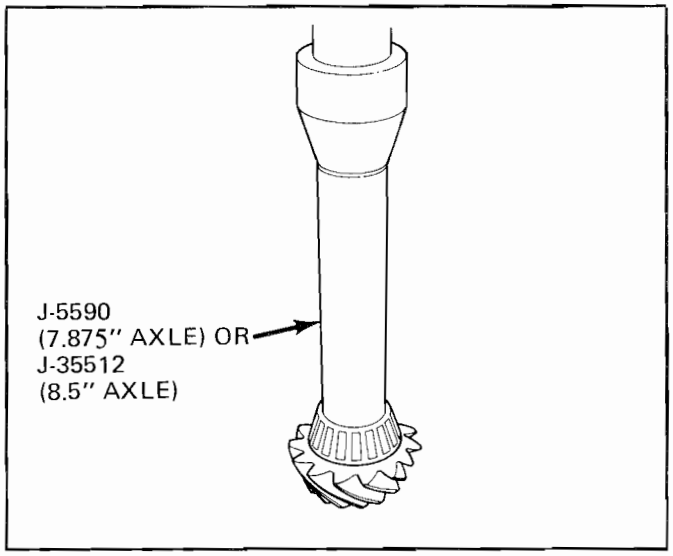


Figure 4B-48 Installing Inner Pinion Bearing

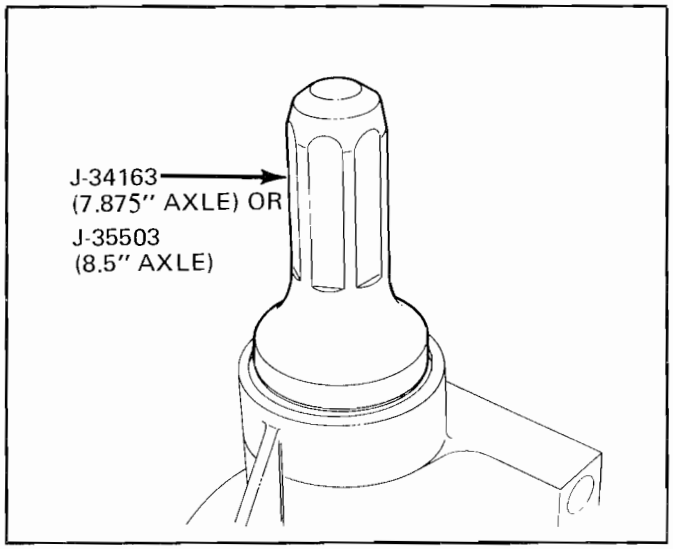


Figure 4B-49 Pinion Oil Seal Installation

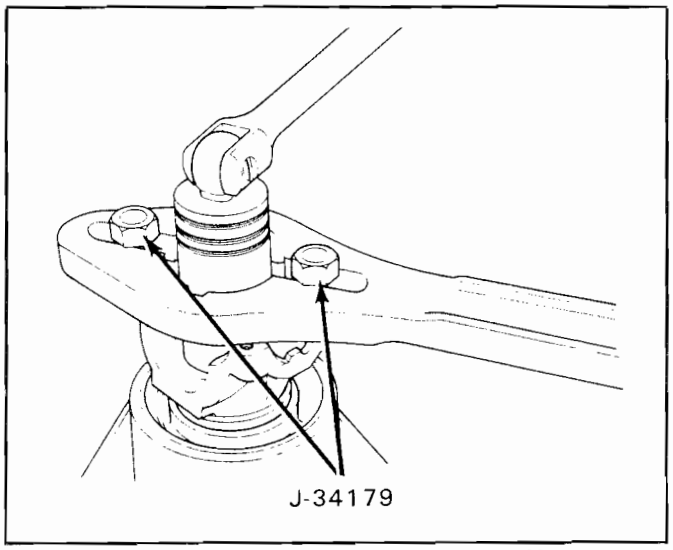


Figure 4B-50 Installing Pinion Nut and Washer

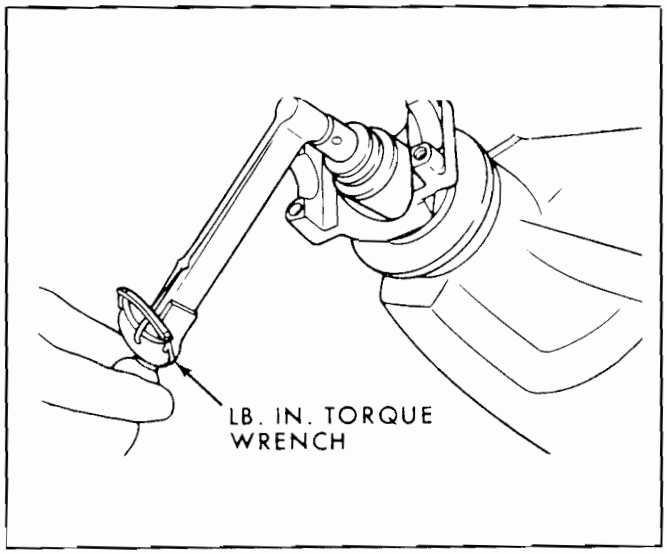


Figure 4B-51 Check Rotating Torque

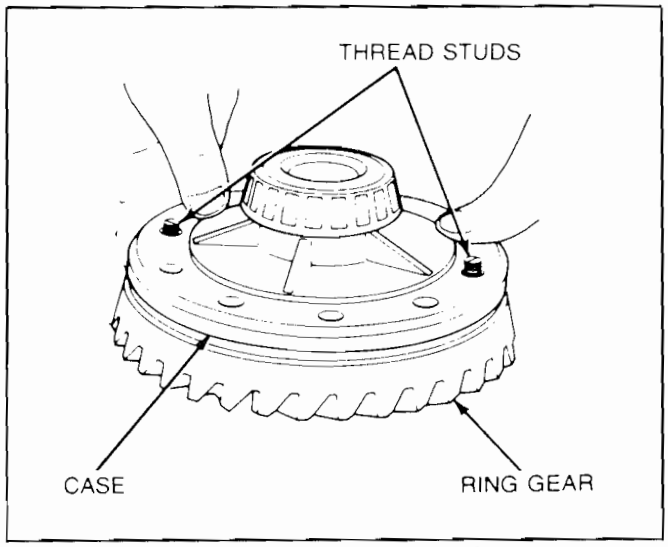


Figure 4B-52 Installing Ring Gear

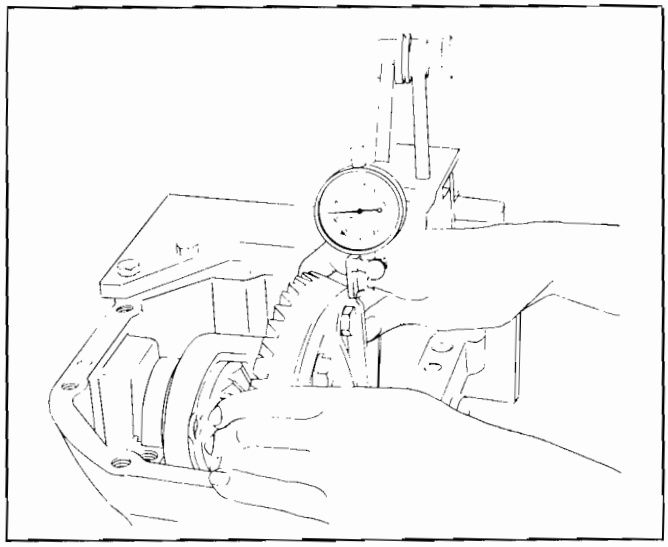


Figure 4B-53 Checking Preload

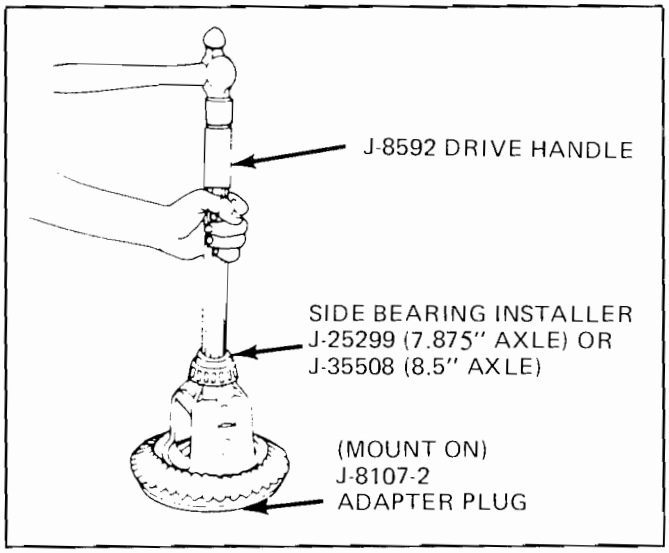


Figure 4B-54 Differential Bearing Installation

Drive Pinion

Installation

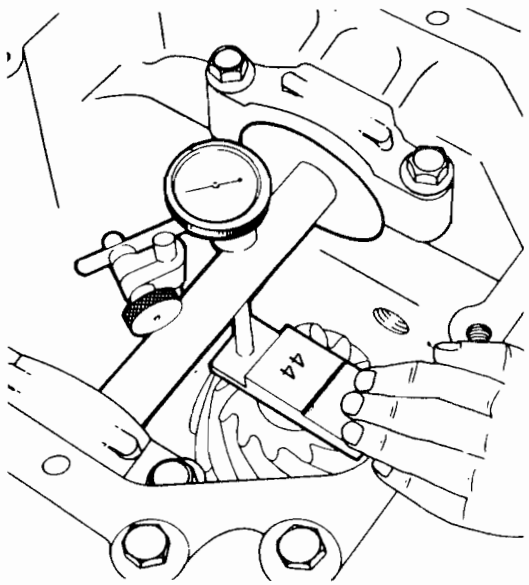
1. Lubricate the inner and outer bearings by applying a small amount of the specified lube on the rollers of the bearing cone. Install the outer bearing and spacer into the carrier.
2. Apply a light coat of oil to the lip of a new pinion oil seal. Using Tool J-34163 (7.875" axle) or Tool J-35503 (8.5" axle) assemble the seal into the carrier as shown (Figure 4B-49).
3. Assemble the preload shims, which are equal in thickness to the original shim stack, onto the pinion. Insert the pinion into the carrier. Assemble the pinion flange onto the spline of the pinion, by tapping flange onto pinion and using holder J-8614-01 . Assemble the pinion washer and a new pinion nut. Torque the pinion nut to 258-285 N·m (190-210 ft. lbs.).
4. Using an inch-pound torque wrench as shown, the pinion rotating torque should read 15-35 in. lbs. (1.69-3.94 N·m) (7.875" axle) or 20-40 in. lbs. (2.25-4.51 N·m) (8.5" axle) with new bearings. To increase the preload, remove shims; to decrease the preload, add shims.

After the pinion, bearings, and seal have been installed, preloaded, and torqued with the measured shim stack, the pinion position can be easily verified by following this procedure (Figure 4B-55).

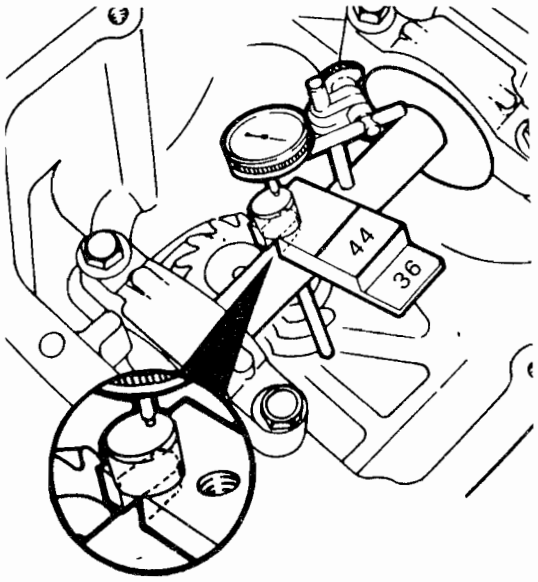
a. Reinstall J-23597-8 (7.875" axle) or J-35506-2 (8.5" axle) Side Bearing Discs and J-23597-1 Arbor into the carrier. Tighten all side bearing caps equally, using a torqe wrench, onto the discs until slight resistance is felt when rotating the arbor.

NOTICE: Failure to tighten side bearing caps equally, with a torque wrench, can result in damage to side bearing caps and/or carrier assembly.

b. Place J-35506-4 Gage Block on top of the pinion button. Position the gage plunger onto the proper gaging step of the gage plate



1. Position J-35506-4 on head of pinion as shown.
2. While holding gauge plate, position plunger on gauge and zero the indicator.
3. Remove gauge plate.



1. Position J-35506-4 under the button as shown.
2. The indicator reading should be within ± .002" (.05 mm) of the etching on the pinion.

Figure 4B-55 Verifying Pinion Depth

for the 7.875" axle or the 8.5" axle. Install J-8001 Dial Indicator to the arbor post. Push the dial indicator downward until the needle rotates approximately 3/4 turn clockwise. Tighten the dial indicator in this position and recheck.

c. While pushing down firmly with one hand on the gage block on top of the pinion, rotate the gage shaft slowly back and forth until the dial indicator reads the greatest deflection. At the point of greatest deflection, set the dial indicator to zero. Repeat the rocking action of the gage shaft to verify the gage setting.

d. After the zero setting is obtained, rotate the gage shaft until the dial indicator plunger does not touch the gage block.

e. Remove the gage block from the top of the pinion and place the groove on the proper side of the block (7.875" or 8.5" axle) around the indicator plunger between the arbor and the plunger head. Be careful not bump or upset the dial indicator during this step.

f. Read the dial indicator. This reading indicates the position of the pinion. An indicator reading within .002" (.05mm) of the etching on the pinion is considered acceptable. If the position is not within plus or minus .002" (.05mm) of the etching of the button on the pinion, the shim stack thickness is incorrect and must be adjusted.

NOTE: The J-8001 Dial Indicator is not a plus-minus type indicator. A reading of -.005" (.005" below zero) will actually show 95 on the indicator. A reading of +.005" will show 5.

If the indicator reading is higher than the pinion marking by more than .002" (.05mm), then the pinion is installed too low and shims must be added. If the indicator reading is lower than the pinion marking by more than .002" (.05mm), then the pinion is installed too high and shims must be removed.

For example, if the etching on the pinion button is +2 and and the indicator reading is -.003", this shim stack is not acceptable because it is not in the correct range of zero to .004. The pinion is installed too high by .005". The shim stack thickness must be reduced by .005".

For example, if the etching on the pinion button is -3 and the indicator reading is +.001", this shim stack is not acceptable because it is not in the correct range of -.005" + -.001". The pinion is installed too low by .004". The shim stack thickness must be increased by .004".

Ring Gear

Installation

1. Be sure the flange face of the differential case is free of nicks or burrs. Assemble the ring gear to

the differential case using new ring gear bolts. Draw the bolts up alternately and evenly. Torque the bolts to 102-115 N·m (75-85 ft. lbs.). (Figure 4B-52).

2. Install the master differential bearings J-34170 (7.875" axle) or J-35505 (8.5" axle) onto the case. Remove all nicks, burrs, dirt, etc., from the hubs to allow the master bearings to rotate freely. Place the differential assembly into the carrier. Bearing caps must be installed with retaining bolts finger tight in order to obtain an accurate reading. Set up the dial indicator as previously shown. Force the differential assembly away from the pinion gear until it is completely seated against the cross bore face of the carrier. With force still applied to the differential case, place the tip of dial indicator on a flat machined surface of the differential case, if available, or on the head of a ring gear screw, and set the indicator at zero (0) (Figure 4B-53).
3. Force the ring gear to mesh with the pinion gear. Rock the ring gear slightly to make sure the gear teeth are meshed. Repeat this procedure several times until the same reading is obtained each time. Be sure the indicator reads zero (0) each time the ring gear is brought back into contact with the pinion. This reading, minus .006 (.15 mm) for preload and backlash adjustment will be the necessary amount of shims between the differential case and differential bearing on the ring gear side. Remove the dial indicator and the differential case from carrier. Remove the master bearings from the differential case.
4. Place the differential case onto the adapter J-8107-2 as shown (Figure 4B-54).
   Assemble the required amount of shims to the ring gear side hub as determined. Place the bearing cone on the hub of the differential case. Use bearing installer J-25399 (7.875" axle) or J-35508 (8.5 axle) and handle J-8592 to seat the bearing cone as shown (Figure 4B-54). The adapter is used to prevent possible damage to hubs while assembling bearing cones.
5. Assemble the remaining shims of the total shim pack. onto the hub opposite of the ring gear. Add an additional .015" - .020" (.38 - .51mm) for the 7.875" axle or .008" - .012" (.20 - .30mm) for the 8.5" axle to the remaining shims, which should give the correct backlash and differential bearing preload. Assemble the differential bearing cone as described above.
   EXAMPLE: In Figure 39 a total of .060" (1.52 mm) was recorded. In Step 3 a total of .026" (.66 mm) was recorded.
   This leaves a balance of .034" (.86 mm) for the opposite side of ring gear. To compensate for preload and backlash subtract .006" (.15 mm) from the ring gear side reading and add .015" - .020" (.38 - .51mm) for the 7.875" axle or .008" - .012" (.20 - .30mm) for the 8.5" axle to the opposite side. The shim pack totals for this example are as follows:
   Ring gear side: original .026" (0.66 mm) reading -.006 (.15 mm) gives .020 (.51 mm).
   Opposite side: original balance of .034" (.86 mm) plus .015" (.38 mm) gives .049" (1.24 mm).

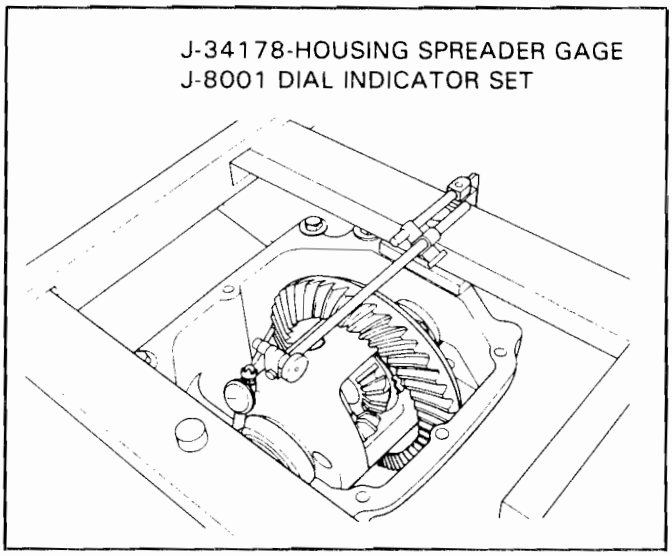
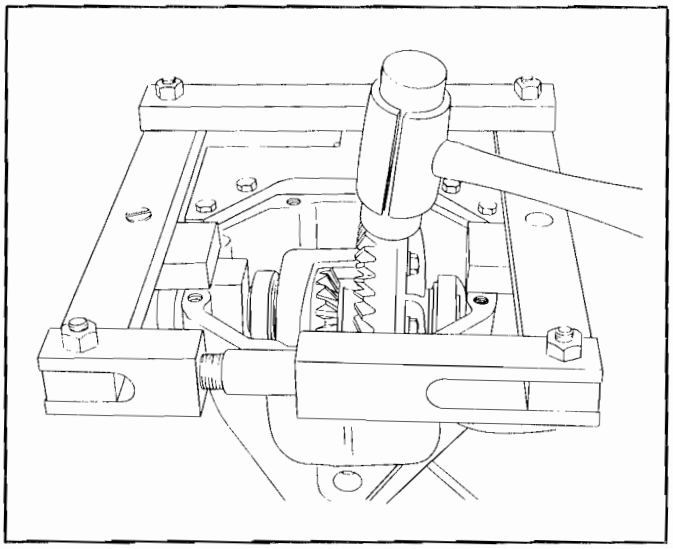


Figure 4B-56 Spreader and Indicator to Carrier


Figure 4B-57 Installing Case Into Carrier

Differential Case

Installation

1. Install the spreader and indicator to the carrier as shown (Figure 4B-56). **DO NOT SPREAD THE CARRIER OVER** 0.010" (.25 mm). Remove the indicator.
2. Assemble the differential bearing cups to the differential bearing. Install the differential assembly into the carrier. Use a rawhide or heavy duty plastic hammer to seat the differential assembly into the cross bore of the carrier. Care should be taken to avoid nicking the teeth of the ring gear or pinion during assembly (Figure 4B-57).
3. Install the bearing caps and bolts. Make sure the letters stamped on the caps correspond in both position and direction with the letters stamped into the carrier. Torque the bearing cap bolts to 57-65 N·m (42-48 ft. lbs.) for the 7.875" axle and

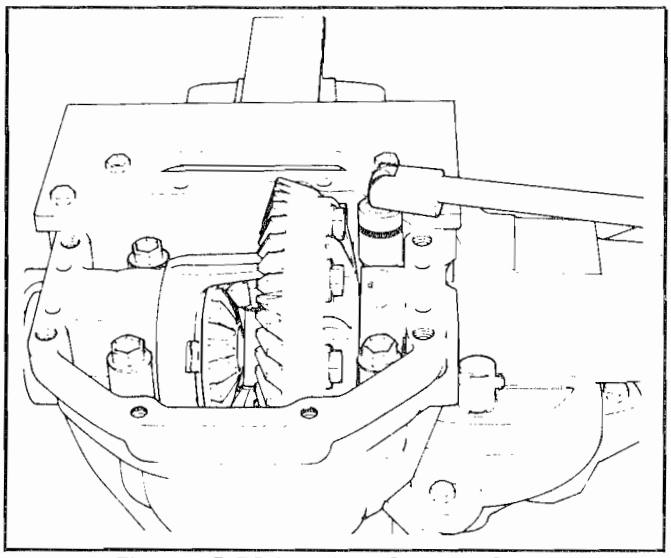


Figure 4B-58 Installing Bearing Caps

79-92 N·m (58-68 ft. lbs. for the 8.5" axle (Figure 4B-58).

4. Check the ring gear and pinion backlash in three equally spaced points with a dial indicator. Backlash tolerance is .006" (.15 mm) to .009" (.23 mm) and cannot vary more than .001" - .0015 (.03 - .04 mm) between points checked.
   a. High backlash is corrected by moving some shims from the opposite side of the differential case to the ring gear side; thus moving the ring gear closer to the pinion.
   b. Low backlash is corrected by moving some shims from the ring gear side of the differential case to the opposite side; thus moving the ring gear away from the pinion.
5. Install the inner yoke shafts into the carrier. Assemble the snap rings onto the shafts. Check end play of yoke shafts.
   The correct end play is .0005" (.013mm) minimum to .0085 (.216mm) maximum. The snap rings come in seven sizes and colors for Model 36 (7.875" axle) and eight sizes and colors for Model 44 (8.5" axle). Refer to Figure 4B-59.

MODEL 36		MODEL 44	
In./mm	Color	In./mm	Color
.050/1.27	PLAIN	.075/1.91	RED
.055/1.40	BLUE	.080/2.03	PURPLE
.060/1.52	YELLOW	.085/2.16	PINK
.065/1.65	GREEN	.090/2.29	PLAIN
.070/1.78	ORANGE	.095/2.41	BLUE
.075/1.91	RED	.100/2.54	YELLOW
.080/2.03	PURPLE	.105/2.67	GREEN
		.110/2.79	ORANGE

Figure 4B-59 Snap Ring Chart

6. Clean mating surfaces of cover and carrier. Apply a continuous 1/4" bead of sealant GM Part No. 1052914, 1052917 or equivalent to mating surfaces.
7. Position cover on carrier and install the six attaching bolts. Torque bolts to alternately to 28-33 N·m (21-24 ft. lbs.) for the 7.875" axle and 43-52 N·m (32-38 ft. lbs.) for the 8.5" axle.

	MODEL 36		MODEL 44	
BOLT/ NUT	N·m	FT. LBS.	N·m	FT. LBS.
COVER BEAM TO CARRIER	28-33	21-24	43-52	32-38
SIDE BEARING CAP	57-65	42-48	79-92	58-68
RING GEAR	102-115	75-85	102-115	75-85
PINION	258-285	190-210	258-285	190-210
FILL PLUG	10-15	8-11	10-15	8-11
TRUNNION STRAP (PINION)	20-27	15-20	20-27	15-20
TRUNNION STRAP (YOKE)	30-40	22-30	30-40	22-30
COVER BEAM TO BODY	110-130	81-96	110-130	81-96
SUPPORT BEAM TO TRANS.	45-55	33-40	45-55	33-40
SUPPORT BEAM TO CARRIER	70-90	51-67	70-90	51-67
	MODEL 36		MODEL 44	
PINION ROTATING TORQUE	N·m	IN. LBS.	N·m	IN. LBS.
(WITH NEW PINION BEARINGS)	1.69-3.94	15-35	2.25-4.51	20-40
	MODEL 36		MODEL 44	
CARRIER SPREAD	mm	IN.	mm	IN.
	.25	.010	.25	.010
RING GEAR BACKLASH	.15-.23	.006-.009	.15-.23	.006-.009
PINION PRELOAD SHIM SIZES (FOR PINION ROTATING TORQUE START WITH 2.28 mm (.090 IN')	.36	.014	.36	.014
	.38	.015	.38	.015
	.41	.016	.41	.016
	.46	.018	.46	.018
	.51	.020	.51	.020
	.53	.021	.53	.021
	.56	.022	.56	.022
	.58	.023	.58	.023
	1.09	.030	1.09	.030
SIDE BEARING PRELOAD	.38-.51	.015-.020	.20-.30	.008-.012
	mm	IN.	mm	IN.
SIDE BEARING PRELOAD SHIM SIZES	.08	.003	.08	.003
	.13	.005	.13	.005
	.25	.010	.25	.010
	.80	.030	.80	.030
PINION DEPTH SHIM SIZES	.51	.020	.51	.020
	.53	.021	.53	.021
	.56	.022	.56	.022
	.58	.023	.58	.023
	.61	.024	.61	.024
	.64	.025	.64	.025
	.66	.026	.66	.026
	.69	.027	.69	.027
	.71	.028	.71	.028
	.74	.029	.74	.029
	.76	.030	.76	.030
	.79	.031	.79	.031
	.81	.032	.81	.032
	.84	.033	.84	.033
	.86	.034	.86	.034
	.89	.035	.89	.035
	.91	.036	.91	.036
	.94	.037	.94	.037
	.96	.038	.96	.038
	.99	.039	.99	.039
	1.02	.040	1.02	.040
	1.04	.041	1.04	.041
	1.07	.042	1.07	.042
	1.09	.043	1.09	.043
	1.12	.044	1.12	.044

Figure 4B-60 Specifications - Model 36 and Model 44

RING GEAR SIZE	RPO	GM PART NUMBER	GEAR RATIO	TEETH NO. RING: PINION	COVER BUSHING COLOR
MODEL 36 7.875" (7-7/8") AUTOMATIC TRANSMISSION ONLY	MXO (STD.)	14093143 14087675	2.59 2.73	44:17 41:15	BLUE BLUE
	MXO W/G92	14087678	3.07	43:14	BLUE
	MXO W/Z51	14087676	3.07	43:14	BLACK
MODEL 44 8.5" (8-1/2") 4 SPD. MANUAL TRANSMISSION ONLY	MM4 (STD.)	14087652	3.07	43:14	BLUE
	MM4 W/Z51	14087652	3.07	43:14	BLACK

Figure 4B-61 Axle Identification Chart

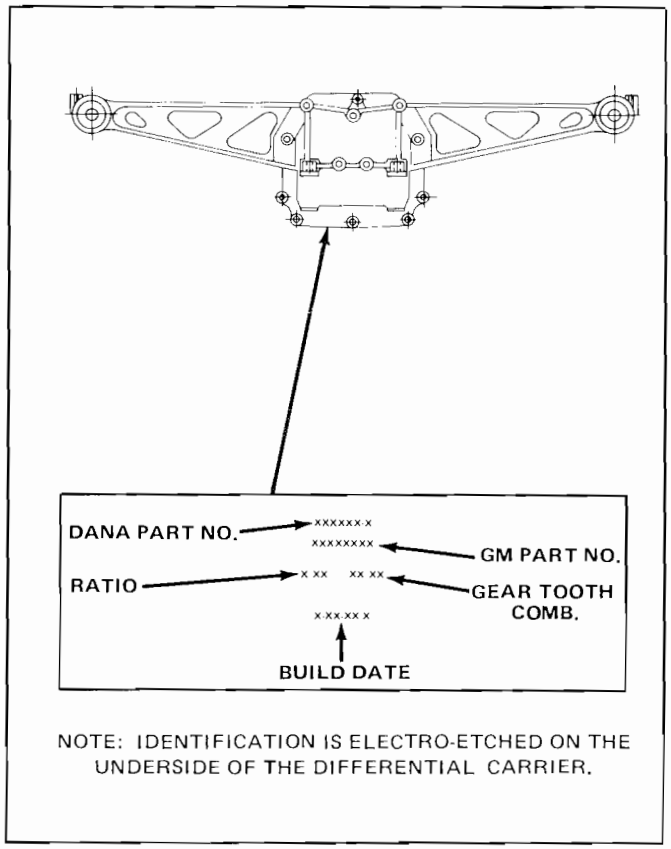


Figure 4B-62 Rear Axle Identification Location

TOOL NAME	TOOL NUMBER	
	MODEL 36	MODEL 44
HOLDING FIXTURE	J-34162	J-34162
CARRIER SPREADER	J-24385-01	J-24385-01
CARRIER SPREADER ADAPTERS	J-24385-20	J-24385-20
CARRIER SPREADER GAGE	J-34178	J-34178
SIDE YOKE SEAL/BEARING REMOVER	J-34171	J-35509
DRIVE HANDLE	J-8592	J-8592
SIDE YOKE BEARING INSTALLER	J-34172	J-35510
SIDE YOKE SEAL INSTALLER	J-26938	J-35511
DRIVE HANDLE	J-8092	J-8092
PINION FLANGE REMOVAL BOLTS	J-34179	J-34179
PINION FLANGE REMOVAL TOOL SET	J-8614-01	J-8614-01
	J-8614-2	J-8614-2
	J-8614-3	J-8614-3
INNER PINION BEARING CUP REMOVER	J-29358-A	J-35501
OUTER PINION BEARING CUP REMOVER	J-29359	J-35502
INNER PINION BEARING REMOVER	J-34165	J-8612-B
DIFFERENTIAL SIDE BEARING REMOVER	J-34168	J-34108-A
DIFF. SIDE BEARING REMOVAL/INSTALLATION ADAPTER	J-8107-2	J-8107-2
PINION OIL SEAL REMOVER	J-23129	J-23129
SLIDE HAMMER	J-6125	J-6125
SIDE GEAR AND CLUTCH PACK REMOVAL TOOL	J-34174	J-34174
CASE TURNING ADAPTER	J-34501	J-34501
MASTER SIDE BEARINGS	J-34170	J-35505
PINION DEPTH GAGE SET		
DIAL GAGE SET	J-8001	J-8001
ARBOR	J-23597-1	J-23597-1
SIDE BEARING DISCS (2)	J-23597-8	J-35506-2
GAGE BLOCK	J-35506-1	J-35506-1
PILOT WASHER	J-34175-2	J-35506-3
WASHER	J-34175-4	J-34175-4
STUD ASSEMBLY	J-21777-43	J-21777-43
INNER PINION BEARING CUP INSTALLER	J-7818	J-8608
OUTER PINION BEARING CUP INSTALLER	J-7817	J-8611-01
INNER PINION BEARING INSTALLER	J-5590	J-35512
PINION OIL SEAL INSTALLER	J-34163	J-35503
DIFFERENTIAL SIDE BEARING INSTALLER	J-25299	J-35508
PINION DEPTH VERIFYING GAGE BLOCK	J-35506-4	J-35506-4

Figure 4B-63 Special Tools

SECTION 5

BRAKES

NOTICE: All Brake attaching fasteners are an important attaching part in that they could affect the performance of vital parts and systems and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of the parts.

CAUTION: When servicing brake parts, do not create dust by grinding, sanding brake linings, or by cleaning brake parts with a dry brush or compressed air. Many brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

NOTICE: Use only D.O.T. 3 or Delco Supreme No. 11 fluid in this brake system. Do not use silicone brake fluid such as Delco Supreme No. 24.

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GENERAL DESCRIPTION

OPERATION OF MASTER CYLINDER

When the brake pedal is depressed, force is transferred through the push rod to the master cylinder primary piston, which moves forward. Under normal conditions, the combination of hydraulic pressure and the force of the primary piston spring move the secondary piston forward at the same time. When the pistons have moved forward so that their primary cups cover the bypass holes, hydraulic pressure is built up and transmitted to the front and rear brake assemblies. Hydraulic pressure behind the caliper pistons forces the pistons outward, causing the brakes to be applied.

OPERATION OF DISC BRAKE

Each caliper has a single piston in an aluminum housing suspended in the mounting bracket on two slide pins. Hydraulic pressure created by applying force to the brake pedal acts equally against the piston and the bottom of the caliper bore to move the piston outward and to slide the caliper inward resulting in a clamping action on the rotor. This clamping action forces the linings against the rotor creating friction to stop the vehicle.

OPERATION OF PROPORTIONING VALVE

The proportioning section of the valve proportions outlet pressure to the rear brakes after a predetermined rear input pressure has been reached. This is done to prevent rear wheel lock-up on cars with light rear wheel loads.

The valve is designed to have a "by-pass" feature which assures full system pressure to the rear brakes in the event of a front brake system failure, full front pressure is retained in the event of rear failure.

The pressure differential warning switch is designed to constantly compare front and rear brake pressure from the master cylinder and energizes the warning light on the dash in the event of a front or rear system failure. The valve and switch are so designed that the switch will latch in the warning position once a failure has occurred. The only way the light can be turned off is to repair the failure.

X Indicates Causes

XX Indicates more possible Causes

CAUSE / SYMPTOM	Brake Pedal Travel Excessive	Brake Pedal Travel Gradually Increases	Excessive Brake Pedal Travel	Excessive Braking Action	Brakes Slow to Respond	Uneven Braking Action (Side to Side)	Brakes Drag	Uneven Braking Action (Front to Rear)	Scraping Noise from Brakes	Brakes Squeak During Application	Brakes Squeak During Stop	Brakes Chatter (Roughness)	Brakes Groan at End of Stop	Brake Light Glows During Stop
Leaking Brake Line or Connection	X	X												X
Leaking Wheel Cylinder or Piston Line	X	X		X				X						X
Leaking Master Cylinder	X	XX												X
Air in Brake System	XX								X					X
Contaminated or Improper Brake Fluid					X	X	X							X
Leaking Vacuum System			XX		X									
Restricted Air Passage in Vacuum Booster			X		XX	X								
Damaged Vacuum Brake Booster			X	X	X	X	XX							
Improperly Assembled Vacuum Brake Booster Valving			X	X	X	X	XX							
Worn Out Brake Lining - Replace			X	X				X	X	X	X	X		X
Uneven Brake Lining Wear - Replace or Correct				X				X	X	X	X	XX		X
Glazed Brake Lining			XX		X			X	X		X	X		
Incorrect Lining Material - Replace			X	X				X	X			X		X
Contaminated Brake Lining - Replace				XX				XX	XX	X	X	X		X
Linings Damaged By Abusive Use - Replace			X	XX				X	X	X	X	X		X
Excessive Brake Lining Dust - Remove with Air			X	XX				XX	XX		X	XX		X
Heat Spotted or Scored Rotor				X				X	X		X	X	XX	X
Out-of-Parallel Brake Rotor													XX	
Excessive Rotor Run-Out													X	
Brake Assembly Attachments - Missing or Loose	X						X	X	X	X		X	X	X
Insufficient Brake Shoe Guide Lubricant						X	X	X	X	XX	XX			
Restricted Brake Fluid Passage or Sticking Wheel Cylinder Piston		X	X		X	X	X	X	X					
Brake Pedal Linkage Interference or Binding			X		X	X	XX							
Improperly Adjusted Parking Brake							X							
Incorrect Front End Alignment								XX						
Incorrect Tire Pressure								X	X					
Loose Front Suspension Attachments								X		XX			X	X
Out-of-Balance Wheel Assemblies													XX	
Operator Riding Brake Pedal	X	X	X				X		X					X

Figure 5-1 Diagnosis Chart

ON-CAR SERVICE

PEDAL TRAVEL

Figure 5-2

At reasonably frequent intervals, the brakes should be inspected for pedal travel, which is the distance the pedal moves toward the floor from a fully released position. Inspection should be made with the brake pedal firmly depressed approximately 70 lbs. (310 N·m) while brakes are cold.

Pump the pedal a minimum of 3 times with the engine off before making pedal travel checks. This exhausts the vacuum assist from the power booster. Pedal travel should not exceed 2.75" (70mm).

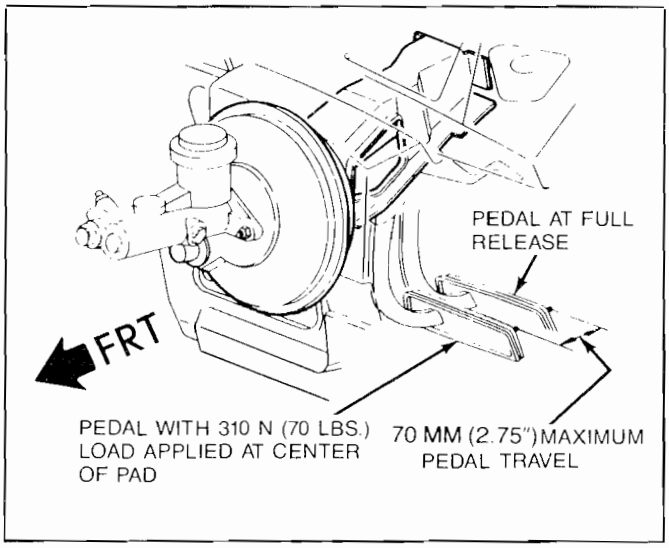


Figure 5-2 Brake Pedal Travel

BRAKE PEDAL

Removal

1. Disconnect the battery ground cable.
2. Remove the close out panel and disconnect the courtesy light.
3. Disconnect the brake pedal from the vacuum booster push rod by removing the retainer and washer, see Figure 5-3.
4. Remove the pivot bolt Number 10, see Figure 5-3.
5. Remove the brake pedal and all associated mounting parts.
6. To install, follow removal procedure in reverse order. Lubricate bushings, pivot bolt and all friction parts with Delco Brake Lube (or equivalent).
7. Adjust the stop lamp switch and check adjustment.

STOP LIGHT SWITCH

Figure 5-4

Adjustment

The design of the switch and valve mounting provides for automatic adjustment when the brake pedal is manually returned to its mechanical stop as follows:

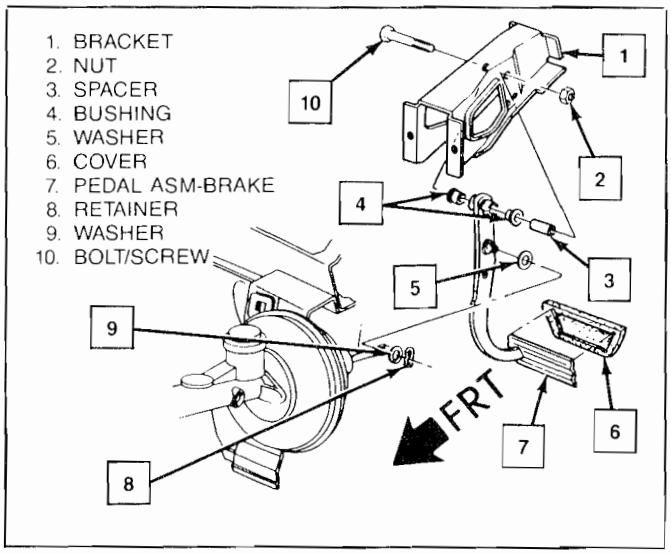


Figure 5-3 Brake Pedal

1. With the brake pedal depressed, insert switch and/or valve assembly into tubular clip until switch body and/or valve assembly seats on tube clip. Note that audible "clicks" can be heard as threaded portion of switch and valve are pushed through the clip toward the brake pedal.
2. Pull brake pedal fully rearward against pedal stop, until audible "click" sounds can no longer as heard. Switch and/or valve assembly will be moved in tubular clip providing proper adjustment.

NOTICE: Excessive force while adjusting stoplight switch may damage power booster.

3. Release brake pedal and then repeat Step 2 to assure that no audible "click" sounds remain.

BRAKE PIPES

Replacement

NOTICE: Never use copper tubing because copper is subject to fatigue cracking and corrosion which could result in brake failure.

1. Procure the recommended tubing and steel fitting nuts of the correct size. (Outside diameter of tubing is used to specify size).
2. Cut tubing to length. Correct length may be determined by measuring old pipe using a cord and adding 1/8" (3.2mm) for each I.S.O. flare.
3. Make sure fittings are installed before starting flare.

   Flare tubing ends using I.S.O. flaring tool such as J-29803. See Figure 5-5 for typical I.S.O. flare.
4. Bend pipe assembly to match old pipe using a tubing bender. Clearance of .75" (19mm) must be maintained to all moving or vibrating parts.

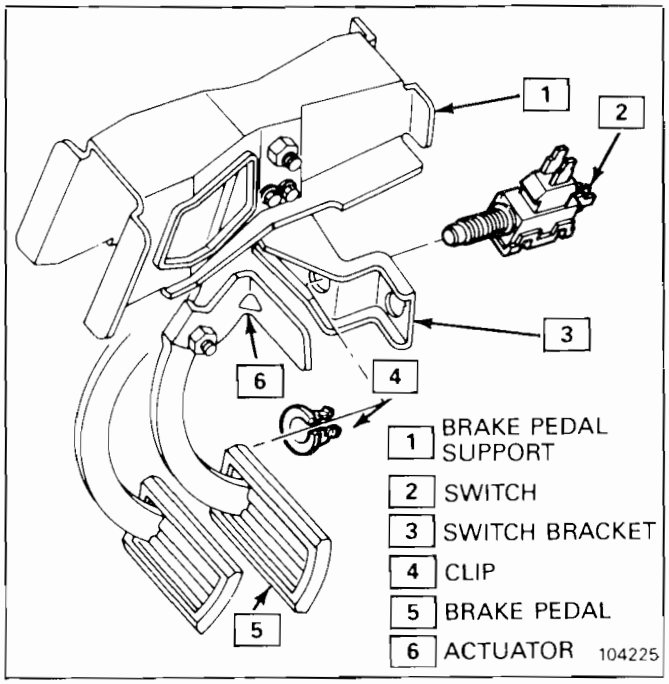


Figure 5-4 Stop Light Switch

BRAKE HOSES

Inspection

The flexible hydraulic brake hose which transmit hydraulic pressure from the steel brake pipe on the frame to the calipers should be inspected every 12 months or 7,500 miles (12 000 km). The brake hose assembly should be checked for road hazard damage for cracks and chafing of outer cover and for leaks and blisters. A light and mirror may be needed for an adequate inspection. If any of the above conditions are observed on the brake hose, it will be necessary to replace it.

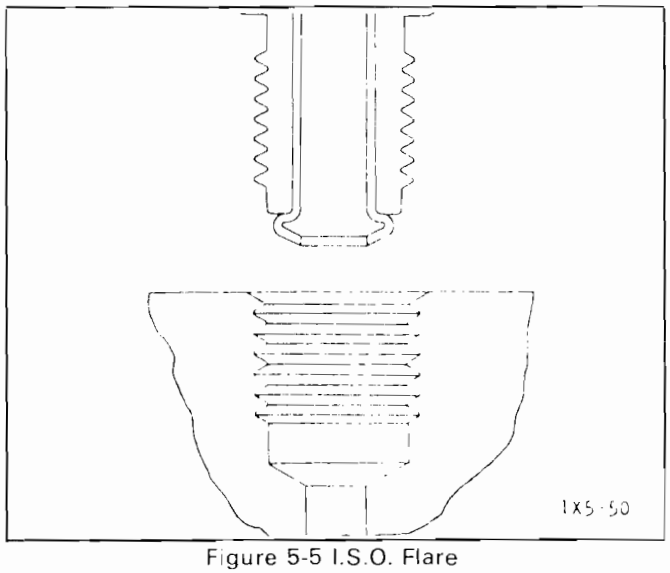


Figure 5-5 I.S.O. Flare

Removal

1. Raise vehicle on hoist.
2. Clean dirt and foreign material from both hose end fittings.
3. Disconnect brake pipe from hose fitting using a back-up wrench on fitting. Be careful not to bend frame bracket or brake pipe. It may be necessary to soak the connections with penetrating oil.
4. Remove "U" clip from female fitting at bracket and remove hose from bracket.
5. Remove hose from caliper, and discard the aluminum gasket on either side of fitting block.

Installation

1. Use new aluminum gasket on hose. Fasten hose to caliper.
2. With weight of vehicle on suspension, pass female fitting through frame or frame bracket. With least amount of twist in hose, install fitting in this position (use hose paint stripe as visual aid). Hose fitting must align with notch in bracket.
3. Install "U" clip to female fitting at frame bracket.
4. Attach brake pipe to hose fitting using a backup wrench on fitting; torque to specifications.
5. Inspect to see that the hose does not make contact with any part of the suspension. Check in extreme right hand and extreme left hand turn conditions. If hose makes any contact, remove and correct.
6. Bleed brake system.
7. Lower vehicle from hoist.

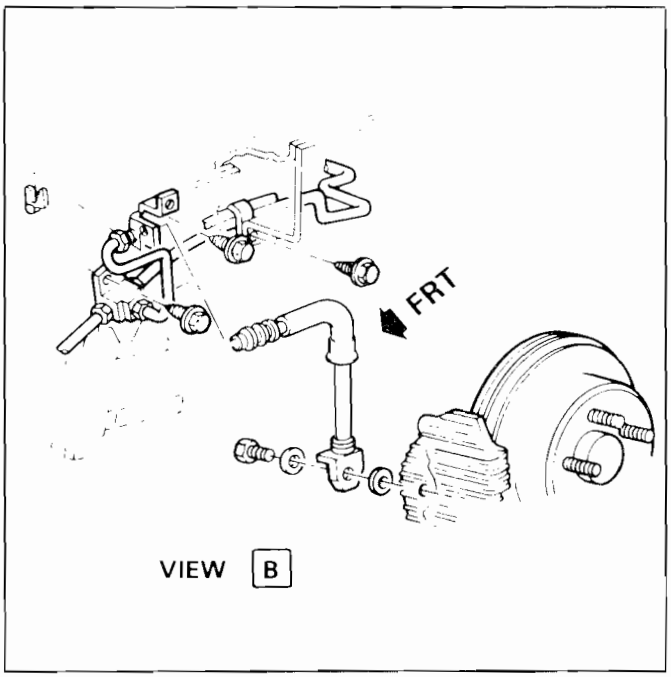
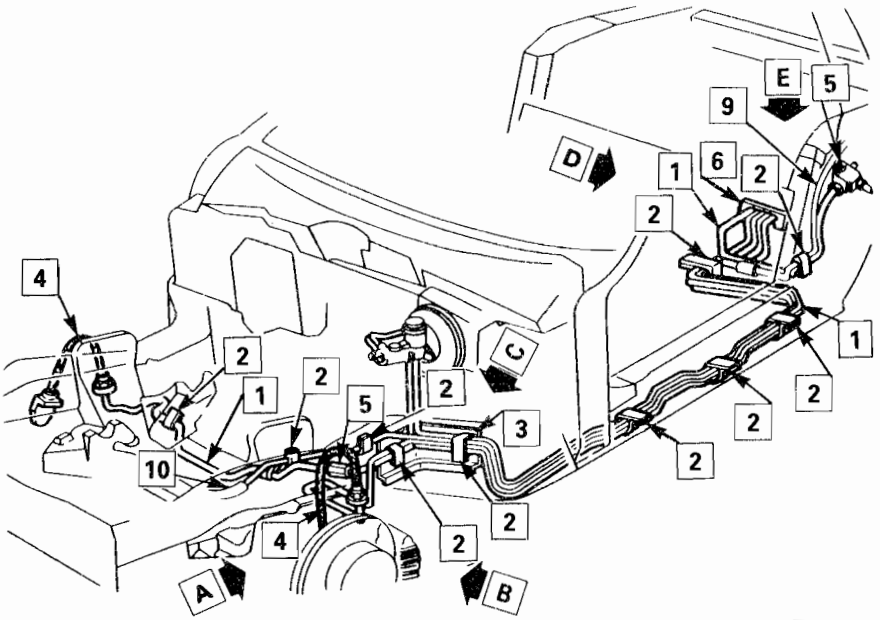


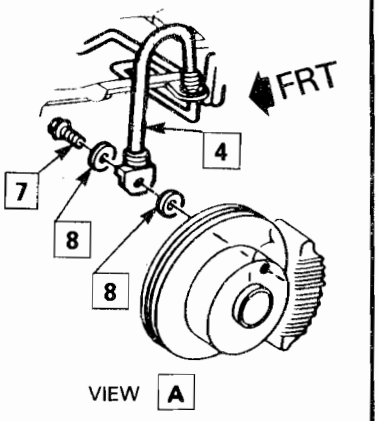
Figure 5-6 Rear Brake Hose

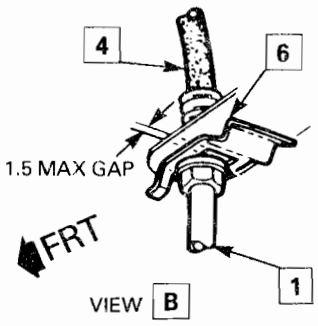
BLEEDING AND FLUSHING BRAKE SYSTEM

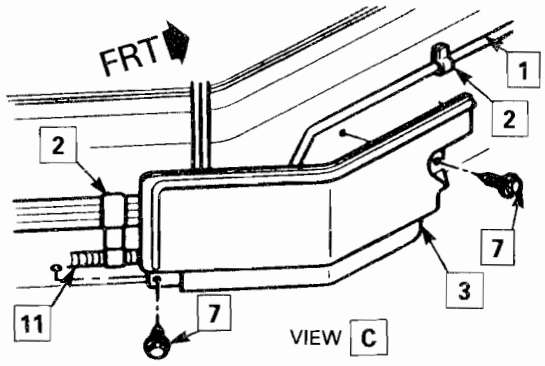
A bleeding operation is necessary to remove air whenever it is introduced into the hydraulic brake system.

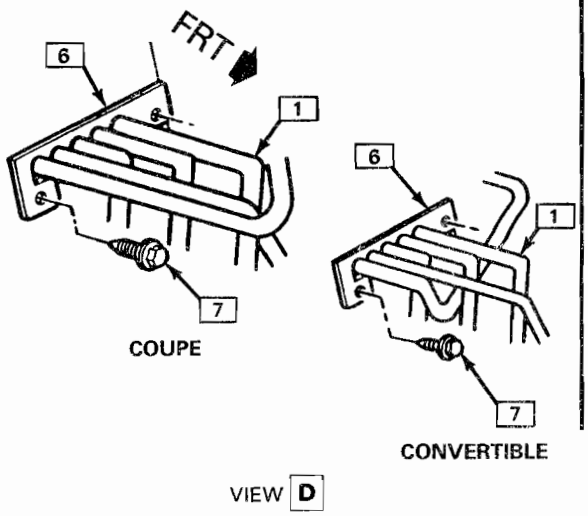
It may be necessary to bleed the hydraulic system at all four wheels if air has been introduced through low fluid level or by disconnecting brake pipes at master cylinder. If brake pipe is disconnected at any wheel, then that wheel only need be bled. If pipes are disconnected at any fitting located between master











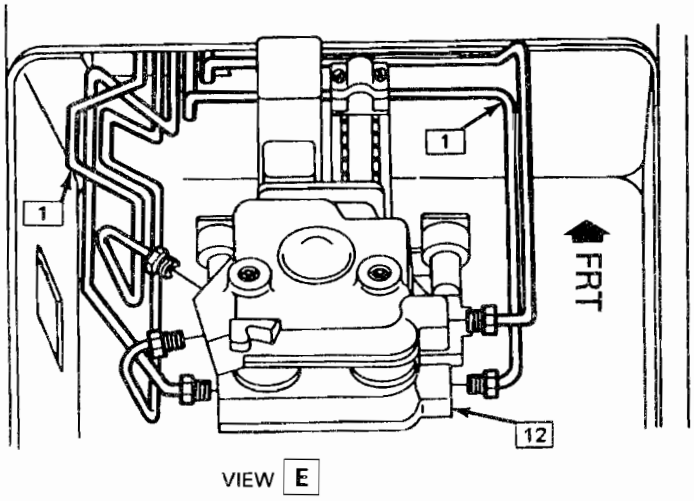


Figure 5-7 Front Hoses and Brake Pipes

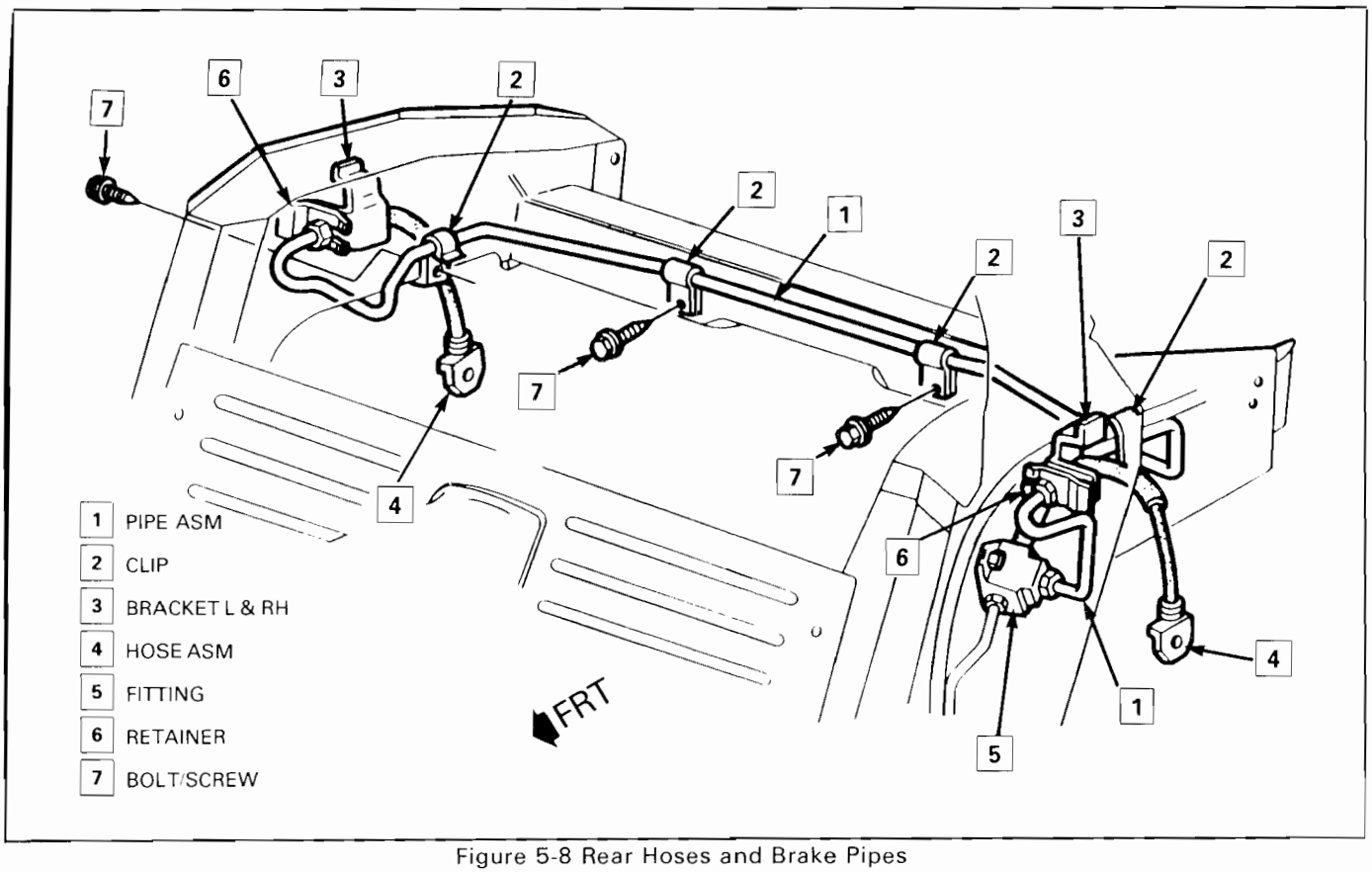


Figure 5-8 Rear Hoses and Brake Pipes

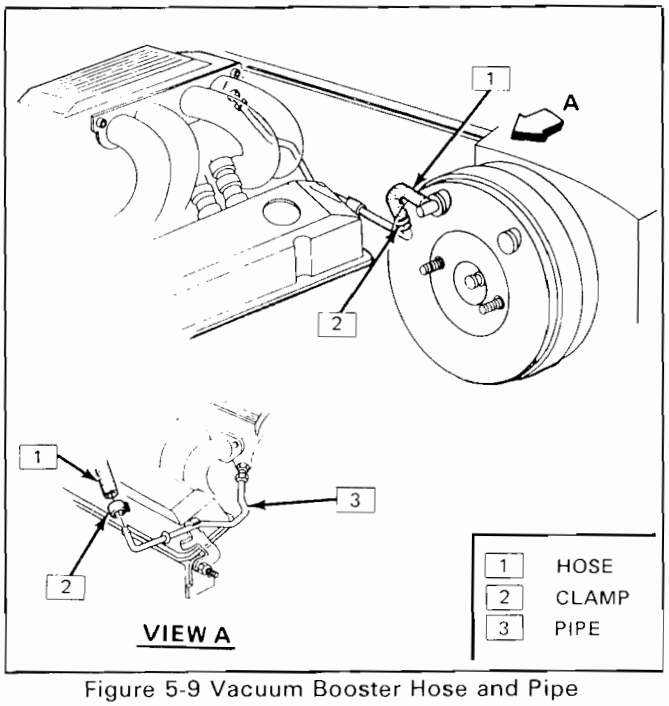


Figure 5-9 Vacuum Booster Hose and Pipe

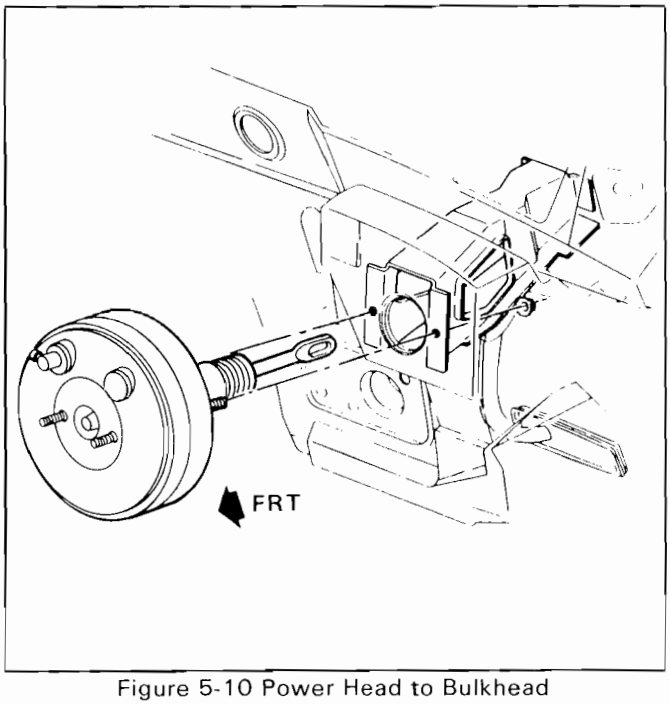


Figure 5-10 Power Head to Bulkhead

cylinder and wheel; then all wheels served by the disconnected pipe must be bled.

Manual Bleeding

Deplete the vacuum reserve by applying the brakes several times.

1. Fill master cylinder with brake fluid and keep at least one-half full of fluid during bleeding operation.

Bleed the brakes in the following sequence: right front, right rear, left rear and left front.

2. With the proper size box end wrench over bleeder valve, attach bleeder tube to valve and allow tube to hang submerged in brake fluid in a clean glass jar (Figure 5-11).
3. Open the bleeder valve and fully depress the brake pedal.
4. Close bleeder valve and release brake pedal.
5. Repeat Steps 3 and 4 until all air is evacuated. Check and refill master cylinder reservoir as required to prevent air from being drawn through master cylinder.
6. Repeat the bleeding procedure at all wheels if the entire system is to be bled.
7. Check the brake pedal feel for "sponginess" and repeat entire bleeding procedure if necessary.

Pressure Bleeding

Pressure bleeding equipment must be of the diaphragm type. That is, it must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture, oil and other contaminants from entering the hydraulic system.

1. Install the correct bleeding adapter to the master cylinder, Tool J-35690.
2. Make sure the pressure tank is at least 1/3 full of Supreme **#11 brake fluid or its equivalent. The bleeder ball must be re-bled each time fluid is added.**
3. Charge the bleeder ball to between 20 and 25 psi (140 and 175 kPa).
4. When ready to begin bleeding, connect hose to master cylinder bleeder adapter and open the tank valve.
5. Bleed the brakes in the following sequence: right front, right rear, left rear and left front.
   Note: Stroke brake pedal while pressure bleeding.
6. With the proper size wrench over the bleeder valve, attach bleeder tube. The discharge end must hang submerged in a clean container partially filled with brake fluid.
7. Open the bleeder valve at least 3/4 turn and allow flow to continue until no air is seen in the fluid.
8. Close the bleed valve, be sure it seals.
9. Repeat Steps 6-8 for the remaining bleeder valves (See Step 5 for sequence).
10. Check the pedal feel for "sponginess" and repeat the entire procedure if necessary.
11. Dispose of all removed brake fluid.
12. Disconnect bleeder equipment from the brake bleeder adapter.
13. Remove bleeder adapter. Wipe all areas dry if fluid was spilled during adapter removal.
14. Fill master cylinder reservoirs to proper level and install master cylinder diaphragm and cover.

FLUSHING BRAKE HYDRAULIC SYSTEM

It is recommended that the entire hydraulic system be thoroughly flushed with clean brake fluid whenever new parts are installed in the hydraulic system.

Flushing is also recommended if there is any doubt as to the grade of fluid in the system. If fluid has been used which contains the slightest trace of mineral oil, all rubber parts that have been subjected to the contaminated fluid should be replaced.

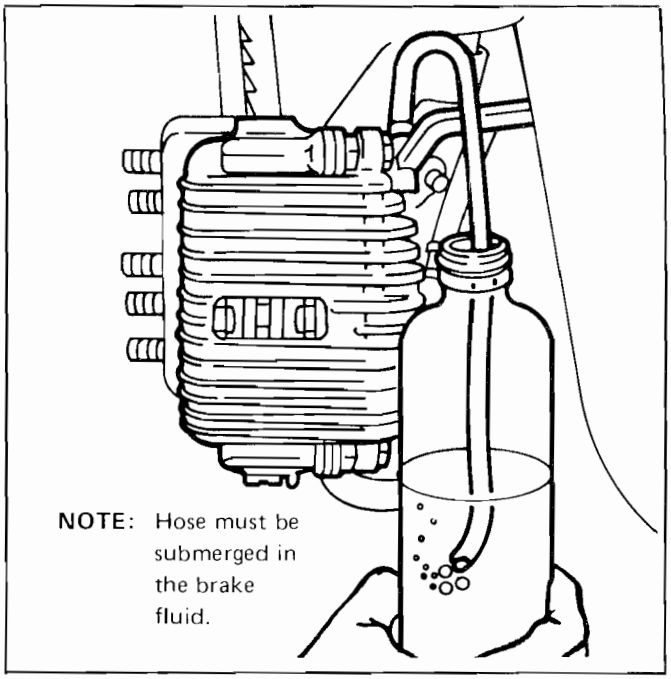
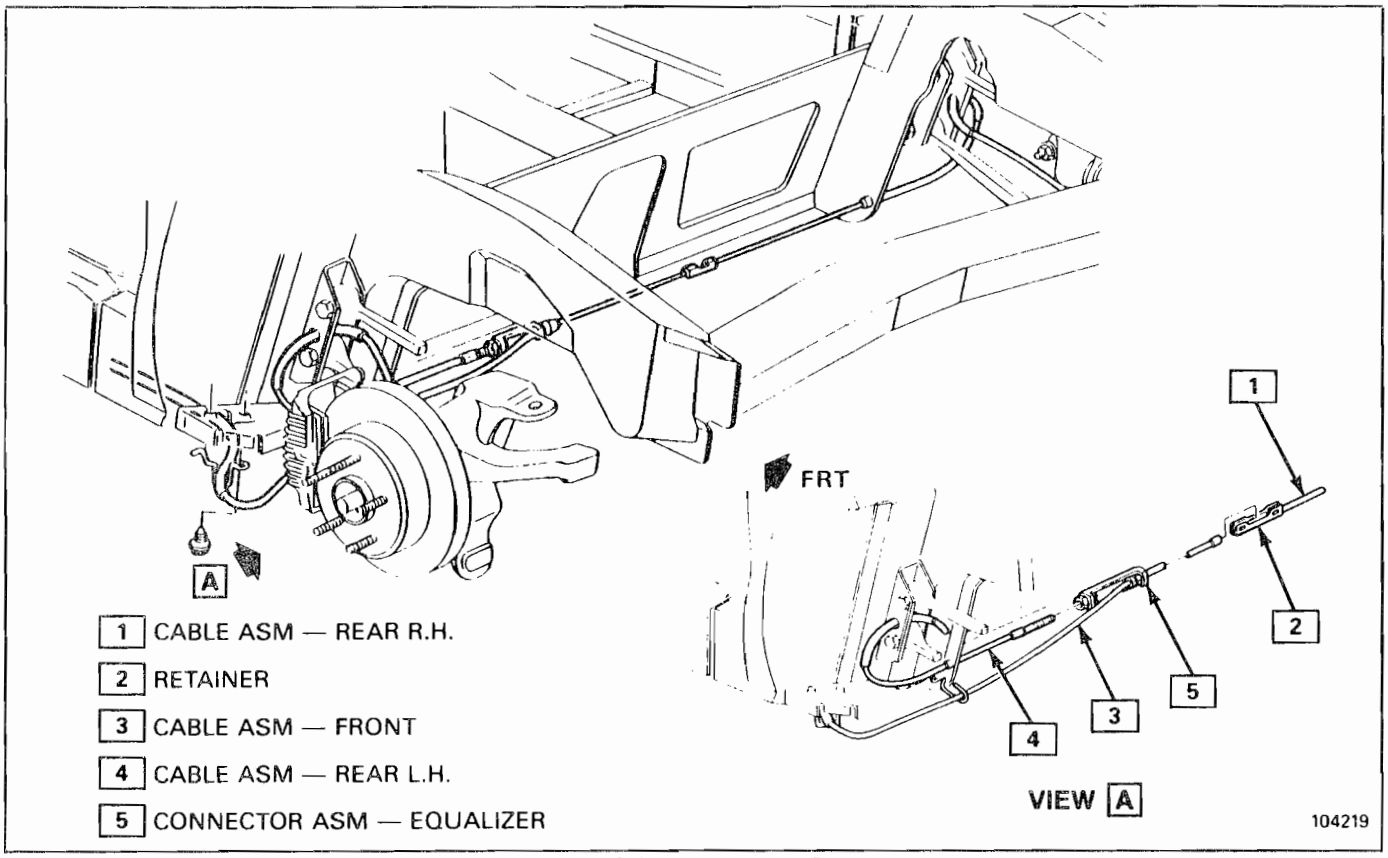


Figure 5-11 Bleeding Brakes

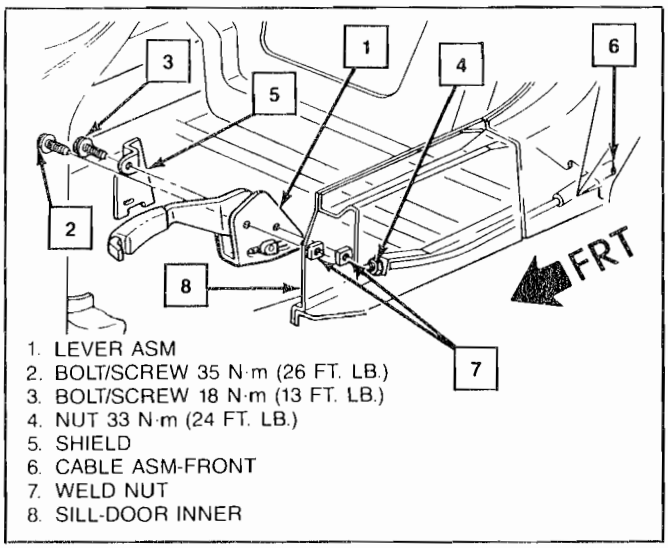
PARKING BRAKE ADJUSTMENT

1. Raise the vehicle and remove the rear wheels, replace two wheel lug nuts opposite of each other on rotor to insure correct disc/drum position.
2. Loosen the park brake cable so that there is no tension on the park brake shoes.
3. Rotate the disc so that the hole in the disc/drum face will align with the star adjuster.
4. To make the adjustment, insert a flat blade screwdriver through the hole in the disc face.
   - **For the driver's side** , move the handle of the tool towards the ceiling to adjust the shoes out and towards the floor to adjust the shoes in.
   - **For the passenger side** , move the handle of the tool towards the floor to adjust the shoes out and towards the ceiling to adjust them in.
5. Adjust one side at a time until there is no rotation of the disc/drum. Then back the star adjuster off 5 to 7 notches. Then go to the opposite side and do the same procedure.
6. Replace rear wheels.
7. Apply the park brake lever two notches.
8. Adjust the cable at the equalizer so that the wheel has a drag.
9. Release the park brake lever and check the wheel for free rotation.
10. Correct adjustment will result in no drag on the wheel.



1 CABLE ASM — REAR R.H.
2 RETAINER
3 CABLE ASM — FRONT
4 CABLE ASM — REAR L.H.
5 CONNECTOR ASM — EQUALIZER

Figure 5-12 Parking Brake Cables



1. LEVER ASM
2. BOLT/SCREW 35 N·m (26 FT. LB.)
3. BOLT/SCREW 18 N·m (13 FT. LB.)
4. NUT 33 N·m (24 FT. LB.)
5. SHIELD
6. CABLE ASM-FRONT
7. WELD NUT
8. SILL-DOOR INNER

Figure 5-13 Parking Brake Lever

PARKING BRAKE CABLE

Front Cable

Removal

1. Raise the vehicle on a hoist.
2. Disconnect the left rear cable at the equalizer.
3. Disconnect the right rear cable at the retainer.
4. Lower the vehicle half way.
5. Remove the lower door sill molding.
6. Remove the cable nut, cable guide and cable in that sequence.
7. For installation, reverse the removal procedures. Include adjusting and checking the park brake operation. See Park Brake Adjustment Procedure.

Rear Left Cable

Removal

1. Raise the vehicle on a hoist.
2. Disconnect the left rear cable at the equalizer.
3. Remove the cable at the frame, caliper mounting bracket and park brake lever at the wheel.
4. For installation, reverse the removal procedure. Include adjusting and checking the park brake operation. See Park Brake Adjustment Procedure.

Rear Right Cable

Removal

1. Raise the vehicle on a hoist.
2. Remove enough tension at the equalizer to disconnect the right parking brake cable at the retainer.
3. Remove the cable at the frame, caliper mounting bracket and park brake lever at the wheel.
4. For installation, reverse the removal procedure. Include adjusting and checking the park brake operation. See Park Brake Adjustment Procedure.

PARK BRAKE CONTROL ASSEMBLY

Removal

1. Raise the vehicle on a hoist.
2. Remove enough tension at the equalizer to remove cable from park brake lever clevis.
3. Lower the vehicle.
4. Remove the lower door sill molding.
5. Disconnect park brake electrical connector.
6. Remove attaching screws at control assembly.
7. For installation, reverse the removal procedure. Include adjusting and checking the park brake operation. See Park Brake Adjustment Procedure.

ROTOR SERVICING AND CHECKING PROCEDURE

Front

Raise vehicle on hoist. Remove wheel assembly and place two lug nuts to ensure proper disc alignment. Clamp a dial indicator to the caliper so that its button contacts the disc at a point about 1/2 inch from the outer edge. When the disc is turned, the indicator reading should not exceed .006". If runout exceeds this amount, the hub and disc assembly should be repaired. See "DISC MACHINING".

Rear

Dial indicate the disc face. If lateral runout of the disc exceeds the bearing end play by .006" (.15mm), the disc should be repaired. See "DISC MACHINING".

PARALLELISM

Parallelism is the measurement of the thickness of the rotor at four or more points around the circumference of the rotor. All measurements must be made at the same distance in from the edge of the rotor.

A rotor that varies over .0005" (.013mm) causes pedal vibration, as well as front end vibration during brake applications. A rotor that does not meet these specifications may be refinished to specifications if precision equipment is available.

TOLERANCE AND SURFACE FINISH

In manufacturing the brake rotor, tolerances of the rubbing surfaces for flatness, for parallelism and for lateral runout are held very closely. The maintenance of these close controls on the shape of the rubbing surfaces is necessary to prevent brake roughness.

In addition to these tolerances, the surface finish must be held to a specified range. The control of the rubbing surface finish is necessary to avoid pulls and erratic performance and to extend lining life.

Light scoring of the rotor surfaces not exceeding .015" (.38mm) in depth, which may result from normal use, is not detrimental to brake operation.

DISC MACHINING

The condition of the disc is a vital factor in the efficient functioning of the brake.

The disc should run true between the pads. The maximum run-out permissible is .006" (0.15mm) and if this tolerance is exceeded, it may cause pedal flutter or increased pedal travel. It is also essential that parallelism is maintained at less than .0005" (0.013mm). The surface of the disc should be smooth. The scratches and light scoring which appear after normal use, are not detrimental, but a heavily scored disc will impair efficiency and increase pad wear.

If the disc run-out exceeds .006" (0.15mm), or is heavily scored, it is permissible to machine the disc but the thickness of the disc must not, under any circumstances, be reduced below the minimum recommended figure of 18.4mm (.724"). The minimum disc thickness must be obtained by removing equal amounts from both disc faces. Under no circumstances should the maximum machining allowance be taken from only one face. In cases where the disc does not clean up within these tolerances, a new disc must be fitted.

ROTOR THICKNESS

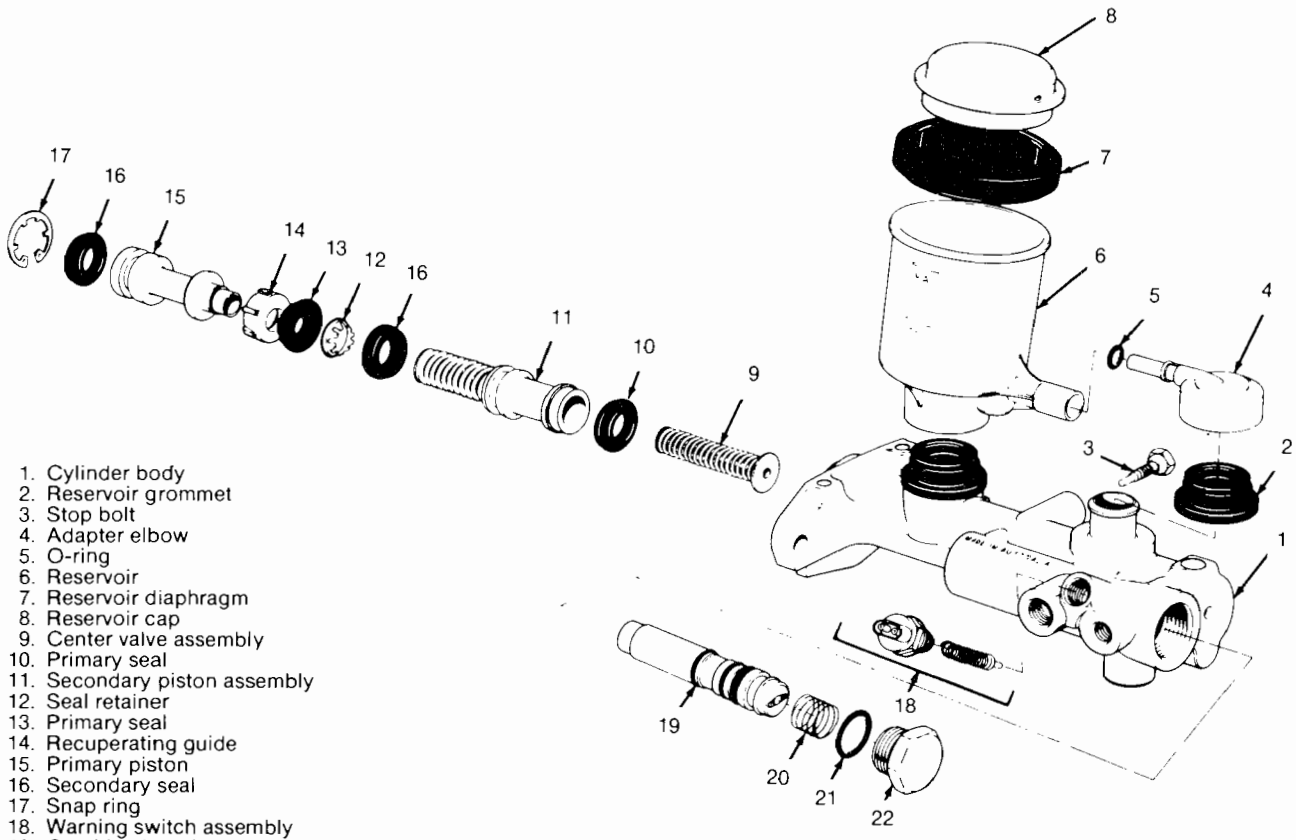
Minimum Disc Face Thickness - 5.0mm per side.
Minimum Thickness after refinishing - 18.4mm (.724").

MASTER CYLINDER ASSEMBLY

GENERAL DESCRIPTION

This master cylinder assembly is an aluminum-plastic composite, featuring an integral proportioning valve/warning switch. The cylinder has dual pressure chambers with a primary piston to supply hydraulic pressure to the rear brakes and a secondary piston to pressurize the front brakes. The cylinder is designed for a conventional front/rear split brake system with one outlet for both front brakes and one outlet for both rear brakes. The master cylinder has one reservoir mounted over, and supplying fluid directly to, the primary pressure chamber. However, the reservoir is also connected to an adapter elbow to supply fluid to the secondary pressure chamber.

NOTICE: Replace all components included in repair kits to service this master cylinder. Lubricate rubber parts with clean fresh Supreme 11 brake fluid or equivalent to ease assembly. Do not use lubricated shop air on brake parts as damage to rubber components may result. If any hydraulic component is removed or brake line disconnected, bleed the system. The torque values specified are for dry unlubricated fasteners. Refer to notice on page 5-1 of this section.



1. Cylinder body
2. Reservoir grommet
3. Stop bolt
4. Adapter elbow
5. O-ring
6. Reservoir
7. Reservoir diaphragm
8. Reservoir cap
9. Center valve assembly
10. Primary seal
11. Secondary piston assembly
12. Seal retainer
13. Primary seal
14. Recuperating guide
15. Primary piston
16. Secondary seal
17. Snap ring
18. Warning switch assembly
19. Combination piston
20. Spring
21. O-ring
22. End plug

Figure 5A-1 Master Cylinder Assembly 1 of 4

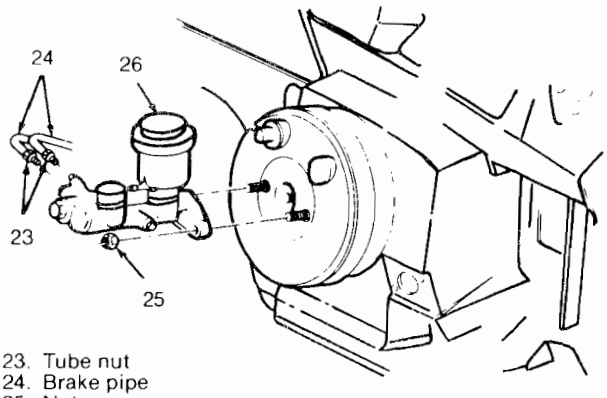
1. REMOVE AND INSTALL MASTER CYLINDER ASSEMBLY

REMOVE

1. Loosen tube nuts (23) and disconnect two hydraulic brake pipes (24).
2. Plug pipes (24) to prevent entrance of contaminates.
3. Remove attaching nuts (25).
4. Remove master cylinder assembly (26).

INSTALL

1. Install master cylinder(26) as shown.
2. Torque attaching nuts (25) to 20-34 N-m (15-25 lb-ft).
3. Attach tube nuts (23) and torque to 16-20 N-m (12-15 lb-ft).



23. Tube nut
24. Brake pipe
25. Nut
26. Master cylinder assembly

DM6155G292

2. MASTER CYLINDER OVERHAUL

DISASSEMBLY

1. Remove reservoir cap (8) and diaphragm (7). Separate cap and diaphragm and discard diaphragm. Inspect cap for cracks or other damage and replace if necessary.
2. Discard any fluid from reservoir or bore.
3. Fully depress the master cylinder pistons with a brass rod or wooden dowel (27) as shown in A and remove stop bolt (3). Then remove snap ring (17) with suitable truarc pliers.

   NOTE: Never remove stop bolt (3) unless both pistons (11 and 15) are fully bottomed in bore.
4. Remove brass rod or wooden dowel (27) and primary piston (15),
5. Gently bump open end of master cylinder body (1) on a piece of wood to dislodge the secondary piston (11) and center valve assembly (9). Discard center valve assembly.
6. Remove the seal retainer (12) by carefully prying open the legs of the seal retainer with a small screwdriver. Discard the retainer.
7. Remove and discard the seals (13 and 16). Remove the recuperating guide (14).

   NOTE: Do not remove or disturb the screw in the secondary piston assembly (11). This will alter piston performance and make replacement of the piston assembly necessary.
8. Remove seals (10 and 16), working over secondary piston lands.
9. Remove the switch assembly (18) being careful to keep the switch spring and probe together as an assembly.
10. Remove the end plug (22).
11. Remove and discard the "O" ring (21) from the end plug (22).
12. Gently bump the master cylinder body (1) on a piece of wood to dislodge the combination piston (19) with spring (20) attached. Discard, do not disassemble this piston as it is serviced as a complete assembly.

ASSEMBLY

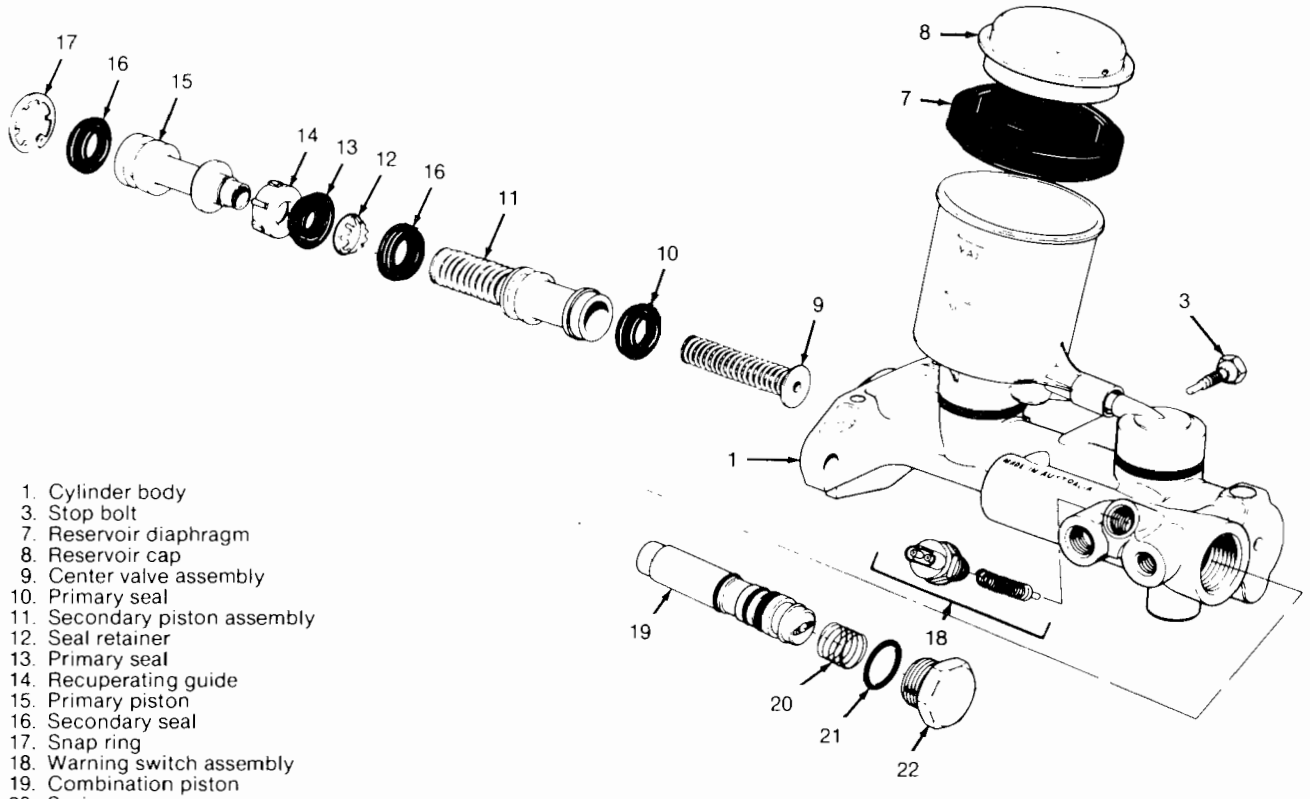
CAUTION: Do not wash new combination piston (19) in any cleaning solution as the internal components are pre-lubricated with special grease.

1. Clean all parts, not included in repair kits, in clean denatured alcohol. Use dry, filtered compressed air to dry parts and blow out all passages in the master cylinder body.
2. Lubricate seals (10 and 16) with clean brake fluid and install on secondary piston (11) as shown in B. Make sure that seal lips face away from each other.
3. Lubricate seal (16) with clean brake fluid and install on primary piston (15) as shown in C, with seal lips facing as shown.
4. Lubricate seal (13) with clean brake fluid. Install recuperating guide (14) and seal (13) on primary piston (15) as shown in C with seal lips facing as shown.
5. Press new retainer (12) onto primary piston (15). Make sure retainer tabs snap into piston groove.
6. Lubricate cylinder bore and piston assemblies with clean brake fluid.
7. Insert new center valve assembly (9) into secondary piston (10, 11 and 16) assembly, then install in cylinder (1) bore.

   NOTE: Do not remove or disturb the screw in the center valve assembly (9). This will alter valve performance and make replacement of the valve assembly necessary.
8. Install primary assembly (12 thru 16) in cylinder (1) bore.
9. Using brass rod or wooden dowel, push on the primary piston (15) until the primary and secondary pistons (15 and 11) bottom in the master cylinder bore. Then, install the stop bolt (3) and torque to 9-12 N-m (7-9 ft-lb.)

   NOTE: Never install stop bolt (3) unless both pistons (11 and 15) are fully bottomed in bore.
10. Install a new snap ring (17) in the master cylinder bore making sure it fits into the groove properly. Remove brass rod or wooden dowel.
11. Lubricate the combination piston bore and a new combination piston (19) with clean brake fluid and insert the piston, open end first, into the bore. Make sure the piston is fully bottomed.
12. Fit spring (20 onto cap end of piston (19) (in cylinder).
13. Lubricate a new O-ring (21) with clean brake fluid and install it over the threaded end of the end plug (22).
14. Install the end plug (22) and torgue to 20-30 N-m(15-22 lb-ft).
15. Install new diaphragm (7) on the reservoir cap (8).
16. Bleed the brake system with bleeder adapter J-35690 (28) as shown in D.
17. Top off fluid level in reservoir to 1/4 inch from top of reservoir and install cap assembly (7 and 8).

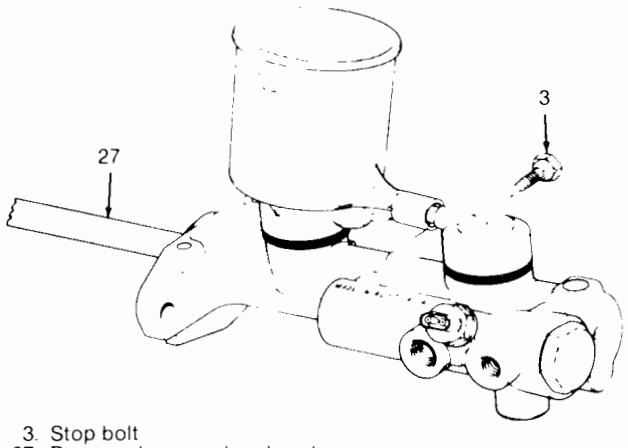
Figure 5A-2 Master Cylinder Assembly 2 of 4



1. Cylinder body
3. Stop bolt
7. Reservoir diaphragm
8. Reservoir cap
9. Center valve assembly
10. Primary seal
11. Secondary piston assembly
12. Seal retainer
13. Primary seal
14. Recuperating guide
15. Primary piston
16. Secondary seal
17. Snap ring
18. Warning switch assembly
19. Combination piston
20. Spring
21. O-ring
22. End plug

DM6155G293

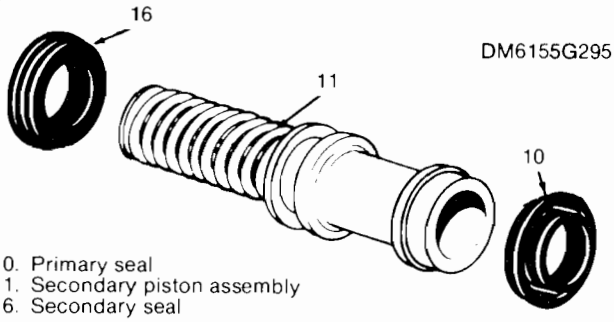
A



3. Stop bolt
27. Brass rod or wooden dowel

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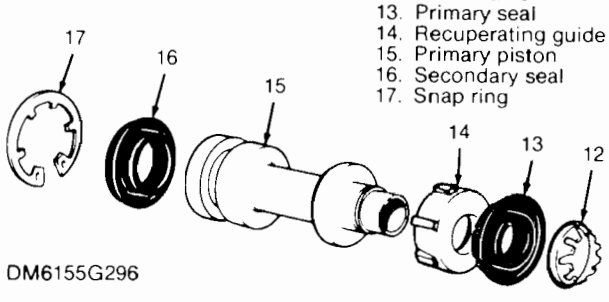
B



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10. Primary seal
11. Secondary piston assembly
16. Secondary seal

C

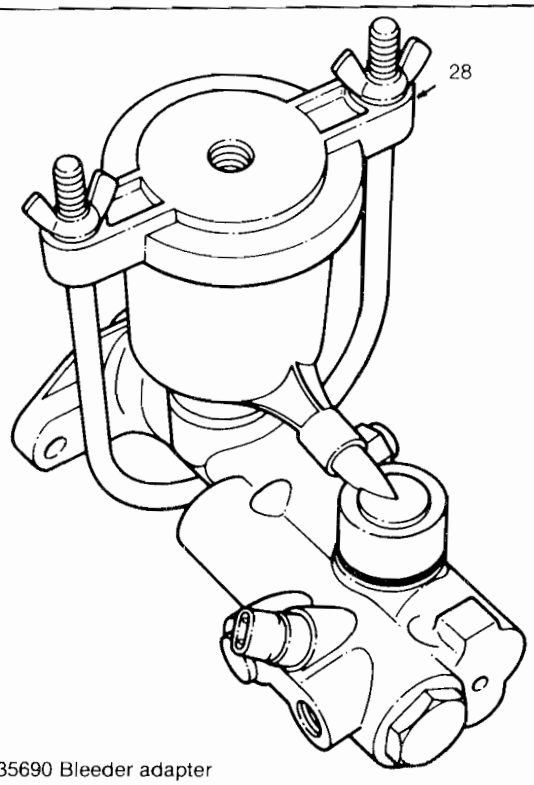


12. Seal retainer
13. Primary seal
14. Recuperating guide
15. Primary piston
16. Secondary seal
17. Snap ring

DM6155G296

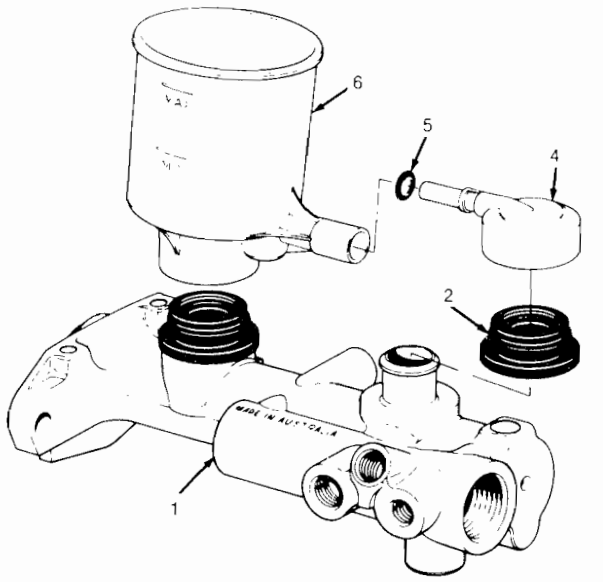
Figure 5A-3 Master Cylinder Assembly 3 of 4

D



28. J-35690 Bleeder adapter

DM6155G297



1. Cylinder body
2. Reservoir grommet
4. Adapter elbow
5. O-ring
6. Reservoir

DM5149G113

3. REMOVE AND INSTALL RESERVOIR AND ADAPTER ELBOW

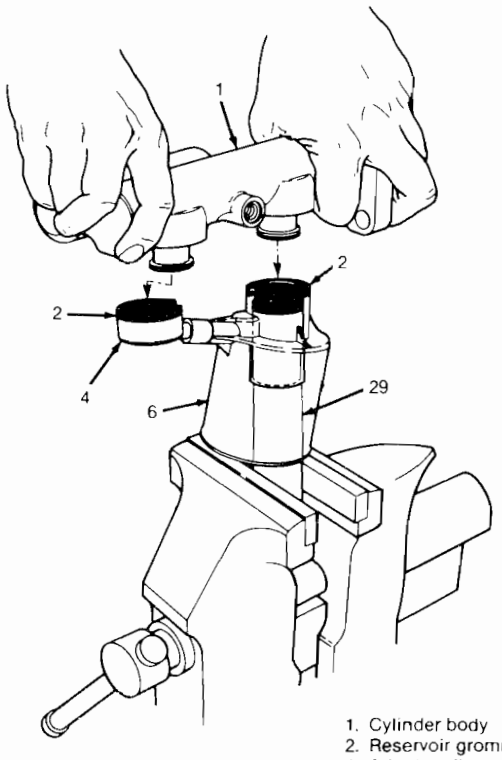
REMOVE

1. Clamp one side of mounting flange on master cylinder body (1) in a vise—do not clamp across master cylinder body.
2. Grasp reservoir (6) and adapter elbow (4) and pull off with rocking motion.
3. Carefully pry reservoir grommets (2) off master cylinder body (1) using care not to damage boss or port on body.

INSTALL

1. Lubricate new reservoir grommets (2) inside and out, with clean brake fluid. Lubricate inside neck on reservoir (6) and adapter elbow (4) with clean brake fluid.
2. By hand, press reservoir grommets (2) into reservoir (1) and adapter elbow until grommet flanges are flush against reservoir elbow.
3. Lubricate o-ring (5) and fit on adapter elbow (4). Insert adapter elbow into reservoir (6).
4. Clamp a 26mm (1.02 in) OD by 22mm (0.87 in) ID tube (29) in a vise as shown in A.
5. Position reservoir (6) and adapter elbow (4) on tube as shown in A.
6. Lubricate cylinder body (1) ports with clean brake fluid.
7. Align adapter elbow (4) with cylinder body (1) port and press body into grommets (2) in reservoir (6) and adapter elbow (4). Make sure flats on body are bottomed against reservoir grommets.

A



1. Cylinder body
2. Reservoir grommet
4. Adapter elbow
6. Reservoir
29. Tube

DM5149G114

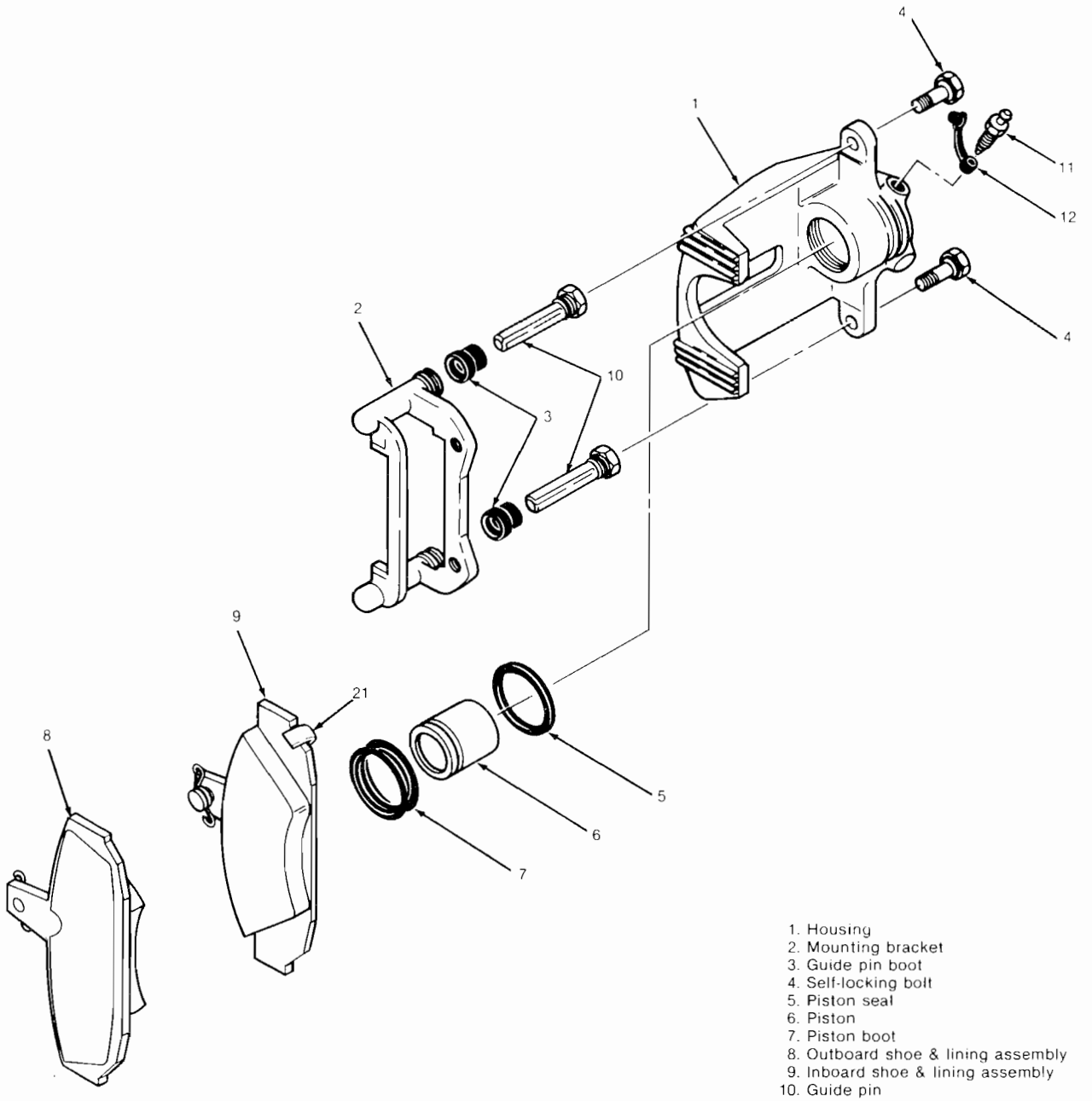
Figure 5A-4 Master Cylinder Assembly 4 of 4

DISC BRAKE CALIPER ASSEMBLY

GENERAL DESCRIPTION

This caliper has a single piston in an aluminum housing suspended in the mounting bracket on two slide pins. Hydraulic pressure, created by applying force to the brake pedal, acts equally against the piston and the bottom of the caliper bore to move the piston outward and to slide the caliper inward resulting in a clamping action on the rotor. This clamping action forces the linings against the rotor creating friction to stop the vehicle.

NOTICE: Replace all components included in repair kits used to service the caliper. Lubricate parts as specified. Do not use lubricated shop air on brake parts as damage to rubber components may result. If any component is removed or line disconnected, bleed the brake system. Replace shoe and linings in axle sets only. The torque values specified are for dry unlubricated fasteners.



1. Housing
2. Mounting bracket
3. Guide pin boot
4. Self-locking bolt
5. Piston seal
6. Piston
7. Piston boot
8. Outboard shoe & lining assembly
9. Inboard shoe & lining assembly
10. Guide pin
11. Bleeder screw
12. Cap
21. Wear sensor

DM2257C105

Figure 5B-1 Disc Brake Caliper Assembly 1 of 4

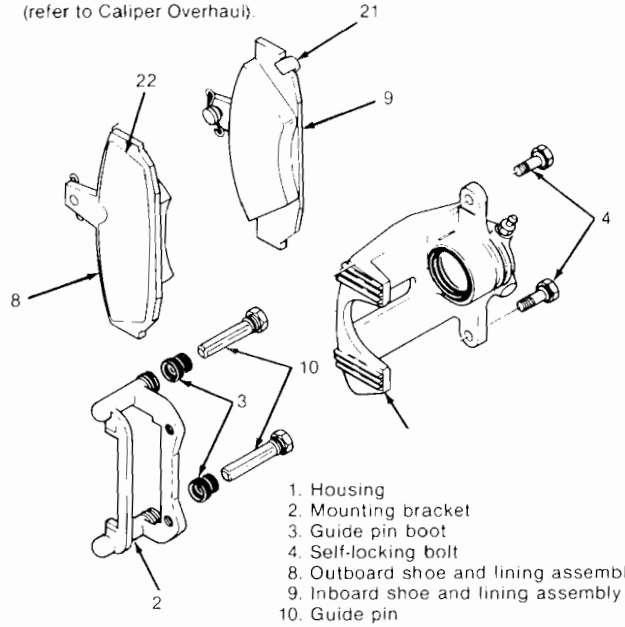
1. REMOVE AND INSTALL SHOE AND LINING ASSEMBLIES

REMOVE

1. Remove 2/3 of the brake fluid from master cylinder reservoirs.
2. Hoist and support vehicle. Mark relationship of wheel to axle. Remove wheel. Inspect rotor — if machining is necessary refer to removal procedures later in this section. Install two lug nuts to hold rotor in position.
3. Position a C-clamp (13) as shown in A and tighten until piston bottoms in bore. Make sure one end of C-clamp rests on inlet fitting bolt head (15) and the other against the outboard shoe (8).
4. Remove and discard the upper caliper self-locking bolt (4), and rotate caliper about the lower bolt (4) and guide pin (10) to expose the shoe and lining assemblies (8 and 9) as shown in B.
5. Remove shoe and lining assemblies (8 and 9).
6. Remove all residue from pad abutments on mounting bracket (2) and from the inside of the housing (1) outer legs.
7. Check guide pins (10) for free movement in bracket (2). Replace guide pins (2) or guide pin boots (3) if corroded or deteriorated (refer to Caliper Overhaul).

INSTALL

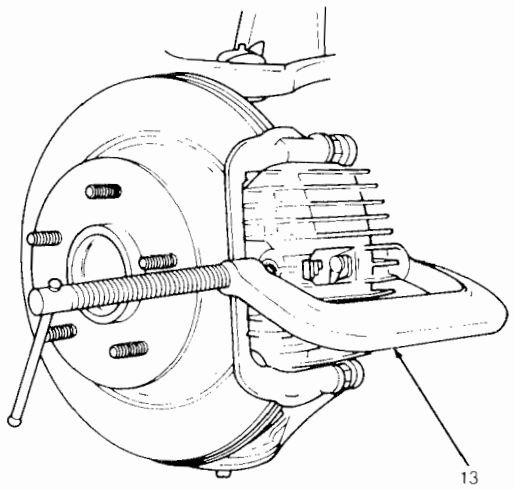
1. Install new shoe and lining assemblies (8 and 9) on mounting bracket (2). NOTE: Shoe and lining (8) with insulator (22) is installed outboard. Shoe and lining (9) with wear sensor (21) is installed inboard. Wear sensor (21) must be in trailing position with forward wheel rotation. If not, use the other inboard shoe and lining in the replacement set.
2. Rotate caliper (1) back into the operating position. Inspect the shoe springs (14). If they are protruding through the inspection hole rotate the caliper and readjust.
3. Install a new self-locking bolt (4) and torque to 30-34 N-m (22-25 lb-ft).
4. Properly install wheel and lower vehicle.
5. Fill master cylinder to proper level. Bleed brakes if inlet fitting was removed.
6. Pump brake pedal firmly and slowly three times to bring pads into contact with rotor.
7. Fill reservoirs to proper level.
8. Road test the vehicle.



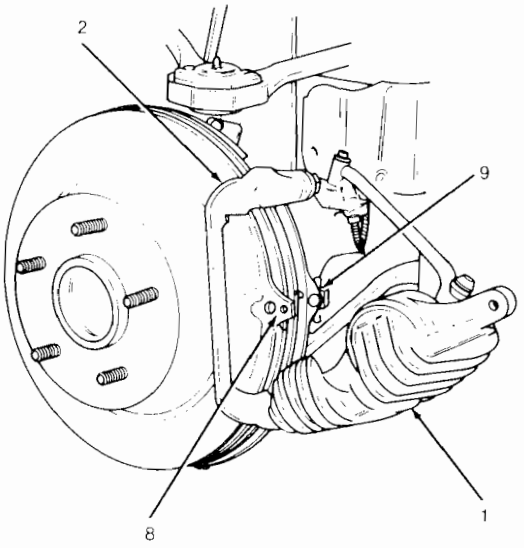
1. Housing
2. Mounting bracket
3. Guide pin boot
4. Self-locking bolt
8. Outboard shoe and lining assembly
9. Inboard shoe and lining assembly
10. Guide pin
14. Shoe springs
21. Wear sensor
22. Insulator

DM2257C105A

A



13 C-clamp



1. Housing
2. Mounting bracket
8. Outboard shoe and lining assembly
9. Inboard shoe and lining assembly

Figure 5B-2 Disc Brake Caliper Assembly 2 of 4

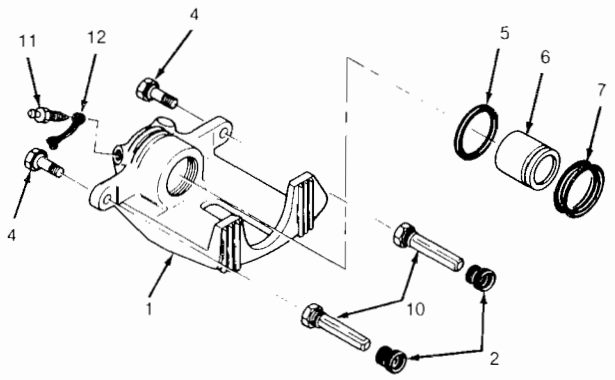
2. CALIPER OVERHAUL

REMOVE

1. Remove inlet fitting (15) as shown in A. Remove and discard washers. Plug the hose (16) to prevent entrance of contaminants. NOTE: If caliper is being removed only for rotor machining do not remove inlet fitting.
2. Remove and discard the two self-locking bolts (4)—not the bracket bolts (17)—as shown in A. NOTE: Remove shoe and lining assemblies only if they are to be replaced or if the mounting bracket is being removed for rotor servicing.
3. Use clean shop towels to pad the interior of the caliper housing (1) and remove piston by directing compressed air into the brake hose port as shown in B. Use care not to damage port threads or sealing face.
4. Inspect piston (6) for scoring, nicks, corrosion and worn or damaged chrome plating. Replace piston if any of these defects are found.
5. Remove piston boot (7) from housing by hand and discard.
6. Remove piston seal (5) from groove in caliper bore with a piece of wood or plastic. Do not use a metal tool of any type as damage to bore may result.
7. Inspect caliper bore. If badly scored or corroded around seal area, replace with a new housing.
8. Remove bleeder screw (11) and then remove rubber cap (12) from bleeder screw.
9. Inspect guide pins (10) for corrosion. If corroded, replace with new pins.

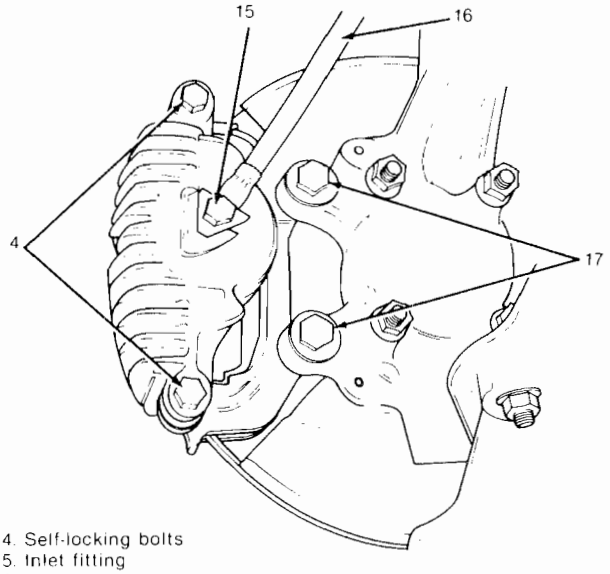
INSTALL

1. Clean all parts, not included in repair kit, in clean denatured alcohol. Use dry, filtered compressed air to dry parts and blow out all passages in the caliper housing (1) and bleeder screw (11). Check piston to bore fit by sliding piston (6) into bore.
2. Install cap (12) and bleeder screw (11). Torque bleeder screw to 8-11 N·m (6-8 lb-ft).
3. Lubricate a new piston seal (5) with silicone grease or clean brake fluid. Install in caliper bore seal groove. Make sure seal is not twisted.
4. Lubricate caliper bore and piston (6) with silicone grease or clean brake fluid.
5. Install boot (7) over end of piston (6) so that fold in boot will face outboard as shown in C. Position piston (6) in caliper and by hand seat boot (7) into groove in caliper bore. Insert piston into caliper bore and by hand push piston down to bottom in bore. Make sure boot is properly seated into groove around piston and into groove in caliper bore.
6. Lubricate guide pins (10) with silicone grease.
7. Install new guide pin boots (3) over guide pins (10).
8. Install guide pins (10) into mounting bracket and fit boots (3) into the grooves of the guide pins (10) and mounting bracket.
9. Install caliper over rotor and into mounting bracket. Make sure shoe springs are positioned properly.
10. Install new self-locking bolts (4) and torque to 30-34 N·m (22-25 lb-ft).
11. Install inlet fitting with two new washers and torque to 44-54 N·m (32-40 lb-ft).
12. Pump brake pedal firmly and slowly three times to bring pads into contact with rotor.
13. Bleed the brakes.



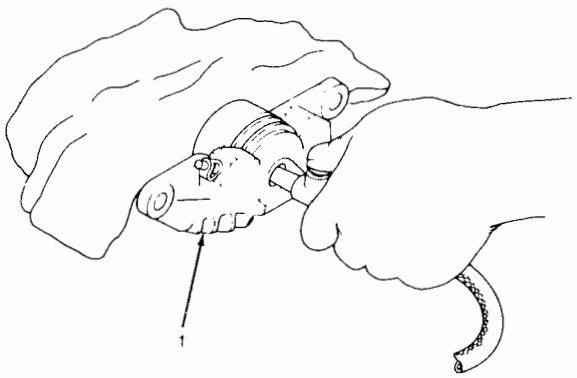
1. Housing
3. Guide pin boot
4. Self-locking bolt
5. Piston seal
6. Piston
7. Piston boot
10. Guide pin
11. Bleeder screw
12. Cap

A



4. Self-locking bolts
15. Inlet fitting
16. Hose
17. Bracket bolts

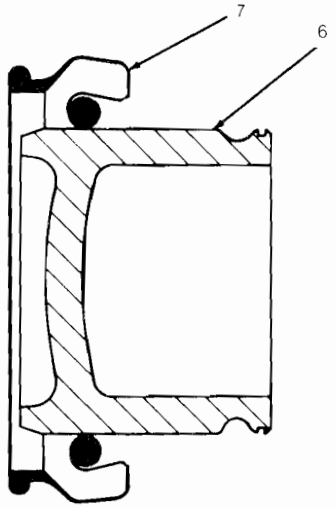
B



1. Housing

Figure 5B-3 Disc Brake Caliper Assembly 3 of 4

C



6. Piston
7 Piston boot

3. REMOVE AND INSTALL FRONT BRACKET

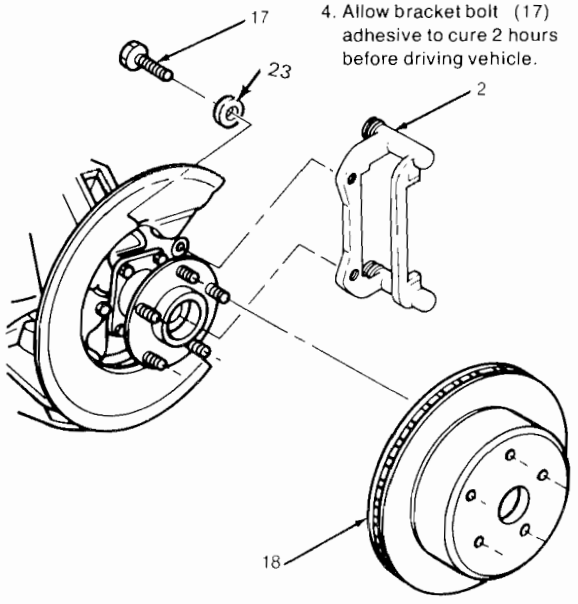
REMOVE

NOTICE: Remove mounting bracket (2) only if damaged or if rotor (18) removal is necessary for machining or other service operations.

1. Remove the two bracket bolts (17) and washers (23). Discard bolts.
2. Remove mounting bracket (2).

INSTALL

1. Clean off residual hardened bolt adhesive from mounting bracket (2) threads, mounting bracket (2) mating surface and knuckle mating surface.
2. Install mounting bracket (2) with washers (23) and two new bracket bolts (17). Torque to 180 N·m (133 lb. ft.)
3. Recheck torque on both bolts immediately.
4. Allow bracket bolt (17) adhesive to cure 2 hours before driving vehicle.



2. Mounting bracket
17. Bracket bolt
18. Rotor
23. Washer

4. REMOVE AND INSTALL REAR BRACKET

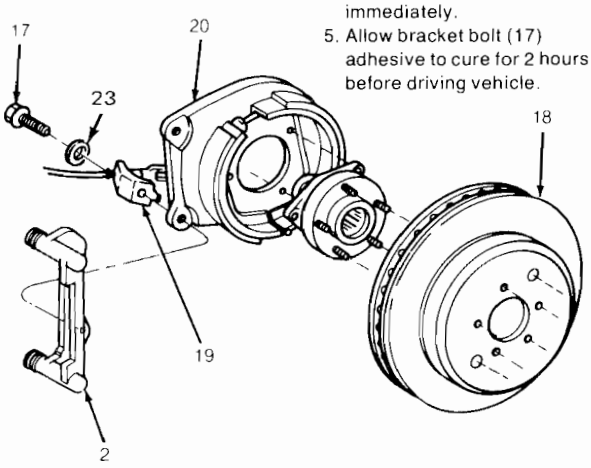
REMOVE

1. Remove the upper bracket bolt (17) and washer (23). Discard bolt.
2. Note position of cable bracket (19). Remove lower bracket bolt (17) and washer (23). Discard bolt.
3. Remove mounting bracket (2).

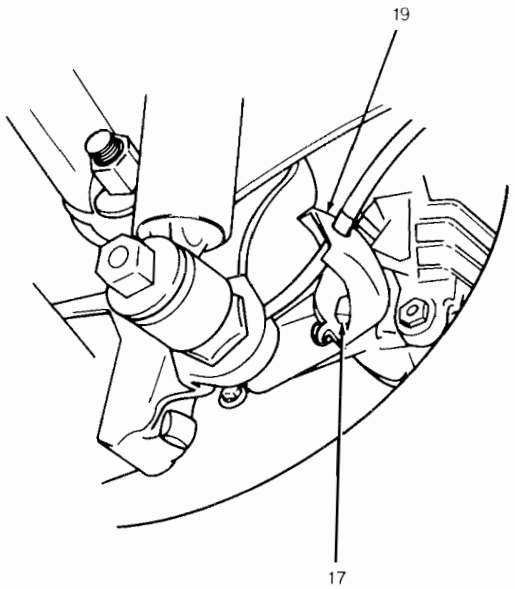
INSTALL

1. Clean off residual hardened bolt adhesive from mounting bracket (2) threads, mounting bracket (2) mating surface and mounting plate (20) mating surface.
2. Install mounting bracket (2) and properly position cable bracket (19) tang into recess in mounting plate (20) with washer (23) and new lower bracket bolt (17) as shown in A.
3. Install new upper bracket bolt (17) and washer (23). Torque both bracket bolts to 95 N·m (70 lb. ft.)
4. Recheck torque on both bolts immediately.
5. Allow bracket bolt (17) adhesive to cure for 2 hours before driving vehicle.

2 Mounting bracket
17 Bracket bolt
18 Rotor
19. Cable bracket
20 Mounting plate
23. Washer



A



17. Bracket bolt
19. Cable bracket

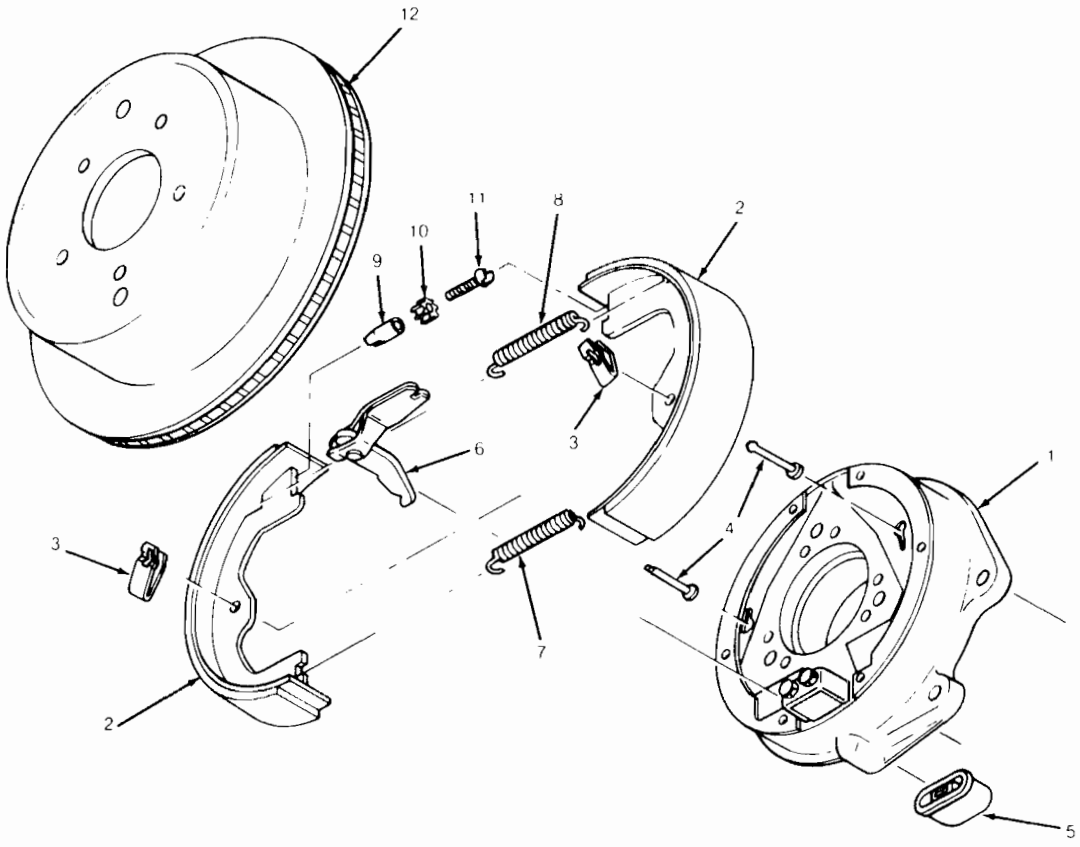
Figure 5B-4 Disc Brake Caliper Assembly 4 of 4

PARKING BRAKE ASSEMBLY

GENERAL DESCRIPTION

This parking brake assembly operates on the Duo Servo principle, where the primary shoe is forced against the drum by application of the parking brake handle. Force from the primary shoe is then transferred to the secondary shoe and multiplied by a wrapping action caused by drum rotation. Stainless steel wear strips are attached to the aluminum housing to prevent premature or excessive wear. All springs are stainless steel and other attaching components are plated.

CAUTION: When servicing wheel brake parts, do not create dust by grinding or sanding brake linings or by cleaning wheel brake parts with compressed air. (A water dampened cloth should be used.) Some wheel brake parts contain asbestos fibers which can become airborn if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm.



1. Mounting plate assembly
2. Shoe and lining
3. Hold-down spring
4. Hold-down pin
5. Boot
6. Lever and strut assembly
7. Shoe return spring
8. Adjuster return spring
9. Adjuster socket
10. Adjuster nut
11. Adjuster screw
12. Rotor

Figure 5C-1 Parking Brake Assembly 1 of 2

1. REMOVE AND INSTALL BRAKE COMPONENTS

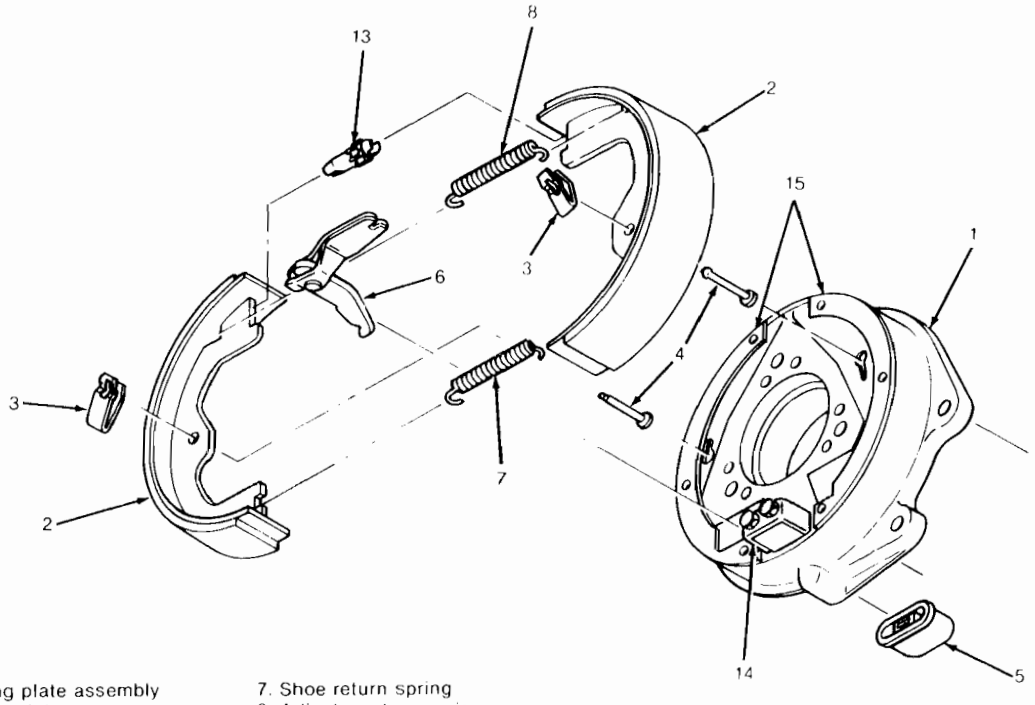
NOTICE: Be careful not to damage wear shims (15). If damaged, it will be necessary to replace the entire mounting plate assembly (1).

REMOVE

1. Spread shoes (2) and remove adjuster assembly (13).
2. Remove the adjuster return spring (8).
3. Disengage the hold down springs (3) and pins (4) by pushing down on the spring (3) and then sliding the pin (4) until it can be removed through the hole at the end of the slot. Remove pins (4) and springs (3) from shoes (2).
4. Remove the shoe return spring (7) with a suitable pair of pliers.
5. Remove the primary and secondary shoe and lining assemblies (2).
6. Disassemble adjuster assembly (13) as shown in A and inspect threads for wear, burrs or damage. Replace as necessary.
7. Clean and inspect wear bracket (14) and wear shims (15) for burrs or damage. If the shims or bracket are unserviceable then it will be necessary to replace the mounting plate assembly (1).
8. Inspect the rubber boot (5) around the lever strut assembly (6). Install a new rubber boot (5) if the old boot is cracked or torn.
9. Inspect springs (7 and 8) for wear or damage and replace as necessary.

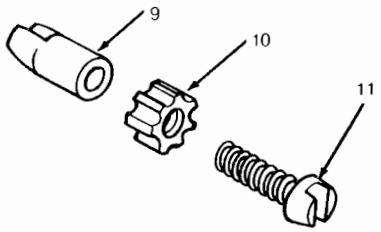
INSTALL

1. Clean all parts, excluding shoe and lining assemblies (2), not being replaced in clean denatured alcohol. Lube wear bracket (14) and wear shims (15) with a thin coating of 5450032 or equivalent.
2. Fit shoe and linings (2) to mounting plate (1). Primary and secondary shoe and assemblies are identical. NOTE: Make sure operating lever and strut assembly (6) is positioned on the wear shims (15), not down in the hole.
3. Install shoe return spring (7) with suitable pliers.
4. Install pins (4) and hold down springs (3) by fitting to shoe and then depressing the spring to extend the pin head through the hole in the backing plate and then down into the slot.
5. Install the adjuster return spring (8).
6. Install the adjuster assembly (13), making sure the star wheel is positioned properly, star wheel toward front.
7. Adjust shoe and lining assemblies and cable after installing rotor and caliper per parking brake adjuster procedure.



1. Mounting plate assembly
2. Shoe and lining
3. Hold-down spring
4. Hold-down pin
5. Boot
6. Lever and strut assembly
7. Shoe return spring
8. Adjuster return spring
13. Adjuster assembly
14. Wear bracket
15. Wear shim

A



9. Adjuster socket
10. Adjuster nut
11. Adjuster screw

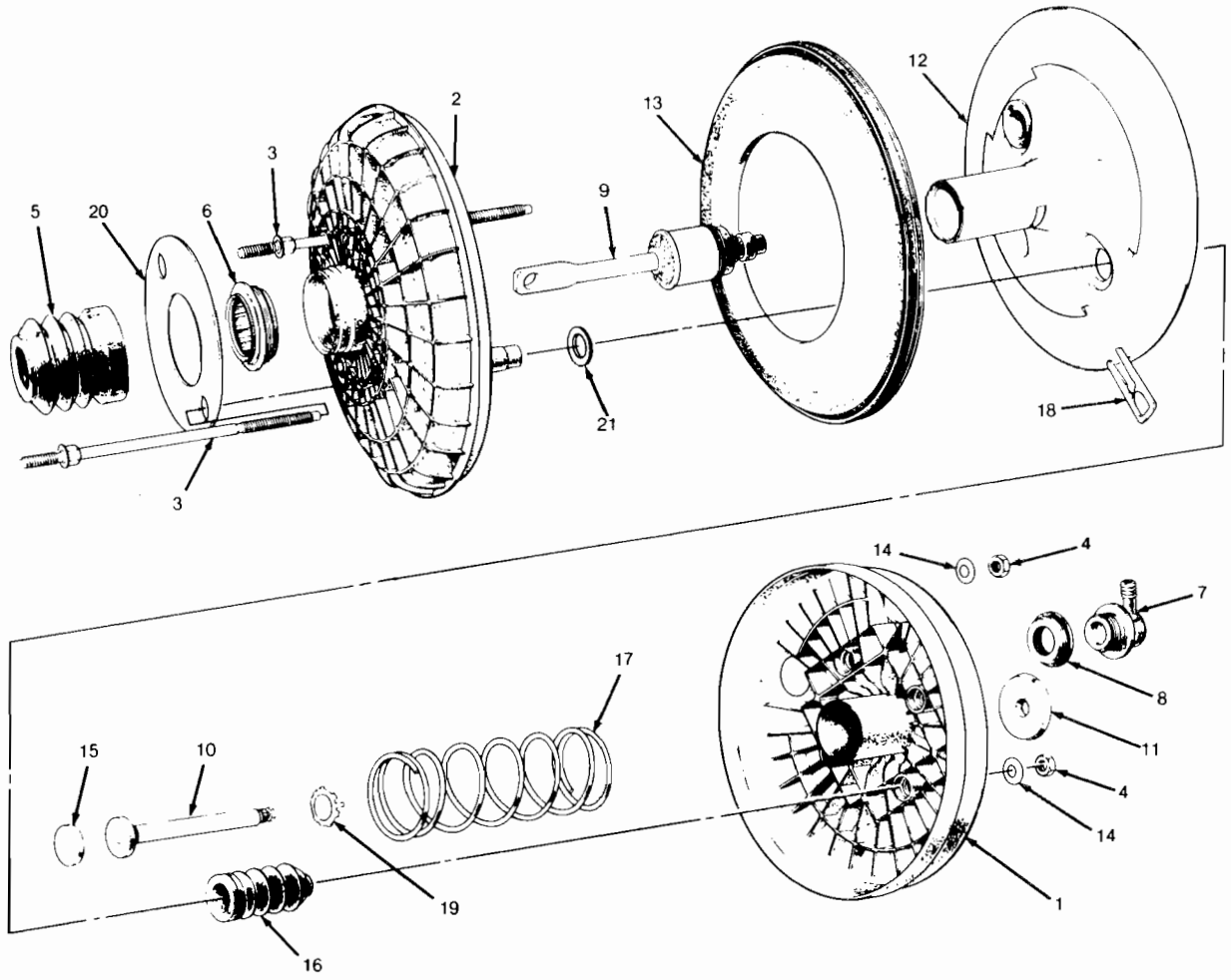
Figure 5C-2 Parking Brake Assembly 2 of 2

POWER HEAD ASSEMBLY — SINGLE DIAPHRAGM

GENERAL DESCRIPTION

This booster is a single diaphragm vacuum suspended unit. In a normal operating mode, with the service brakes in the released position, the booster has vacuum on both sides of its diaphragm. When the brakes are applied, air at atmospheric pressure, is admitted to the back side of the diaphragm to provide power assist. Tie rods extend through the booster and are attached to the cowl on one end and the master cylinder on the other.

NOTICE: Use all components included in repair kits to service this booster. Lubricate rubber parts, where indicated, with silicone grease. The torque values specified are for dry, unlubricated fasteners. If any hydraulic component is removed or brake line disconnected, bleed the brake system.



1. FRONT SHELL
2. REAR SHELL
3. TIE ROD
4. NUT
5. BOOT
6. REAR SEAL
7. VACUUM CHECK VALVE
8. GROMMET
9. VALVE ASSEMBLY
10. OUTPUT ROD
11. FRONT SEAL
12. VACUUM PISTON
13. DIAPHRAGM
14. CONED SPRING
15. REACTION DISC
16. TIE ROD BOOT
17. RETURN SPRING
18. STOP PLATE
19. RETAINER
20. GASKET
21. STEEL WASHER

DM4311E133

Figure 5D-1 Power Head Assembly 1 of 3

1. REMOVE AND INSTALL BOOSTER.

REMOVE

1. Remove nuts attaching master cylinder to booster tie rods (3) and remove master cylinder.
2. Disconnect vacuum hose from vacuum check valve (7).
3. Disconnect pushrod [part of valve assembly (9)] from brake pedal.
4. Remove nuts from booster tie rods (3) and remove booster.

INSTALL

1. Attach booster to cowl with nuts on booster tie rods (3).
2. Attach push rod [part of valve assembly (9)] to brake pedal.
3. Connect vacuum hose to vacuum check valve (7).
4. Attach master cylinder with nuts on booster tie rods (3).

2. DISASSEMBLY AND ASSEMBLY

DISASSEMBLE

1. Remove vacuum check valve (7).

   CAUTION: Failure to hold shells (1 and 2) together will result in shell (1) flying off by action of spring (17).
2. Unscrew nuts (4) approximately 1/2 inch back on tie rods (3), but do not remove. If shells (1 and 2) stick together, pry them apart with a thin blade screwdriver using extreme care not to chip or otherwise damage either shell. When bond between shells is broken, spring (17) will force front shell (1) out against nuts (4). Then, holding shells together, completely remove nuts (4) and coned springs (14).
3. Remove front shell (1) and return spring (17).
4. Remove grommet (8) and front seal (11) from front shell (1).
5. Remove boot (5), tie rods (3) and gasket (20) from rear shell (2).
6. Loosen bead of diaphragm (13) from rear shell (2). Remove ends of tie rod boots (16) from posts in rear shell (2) and remove vacuum piston (12). Remove diaphragm (13) and tie rod boots (16) from vacuum piston (12).
7. Remove rear seal (6) and washers (21) on tie rod posts from rear shell (2).
8. Remove output rod (10), retainer (19) and reaction disc (15).
9. Remove stop plate (18) from vacuum piston (12) by pressing on open end of stop plate (18) and pulling on closed end.
10. Remove valve assembly (9) from vacuum piston (12).

ASSEMBLE

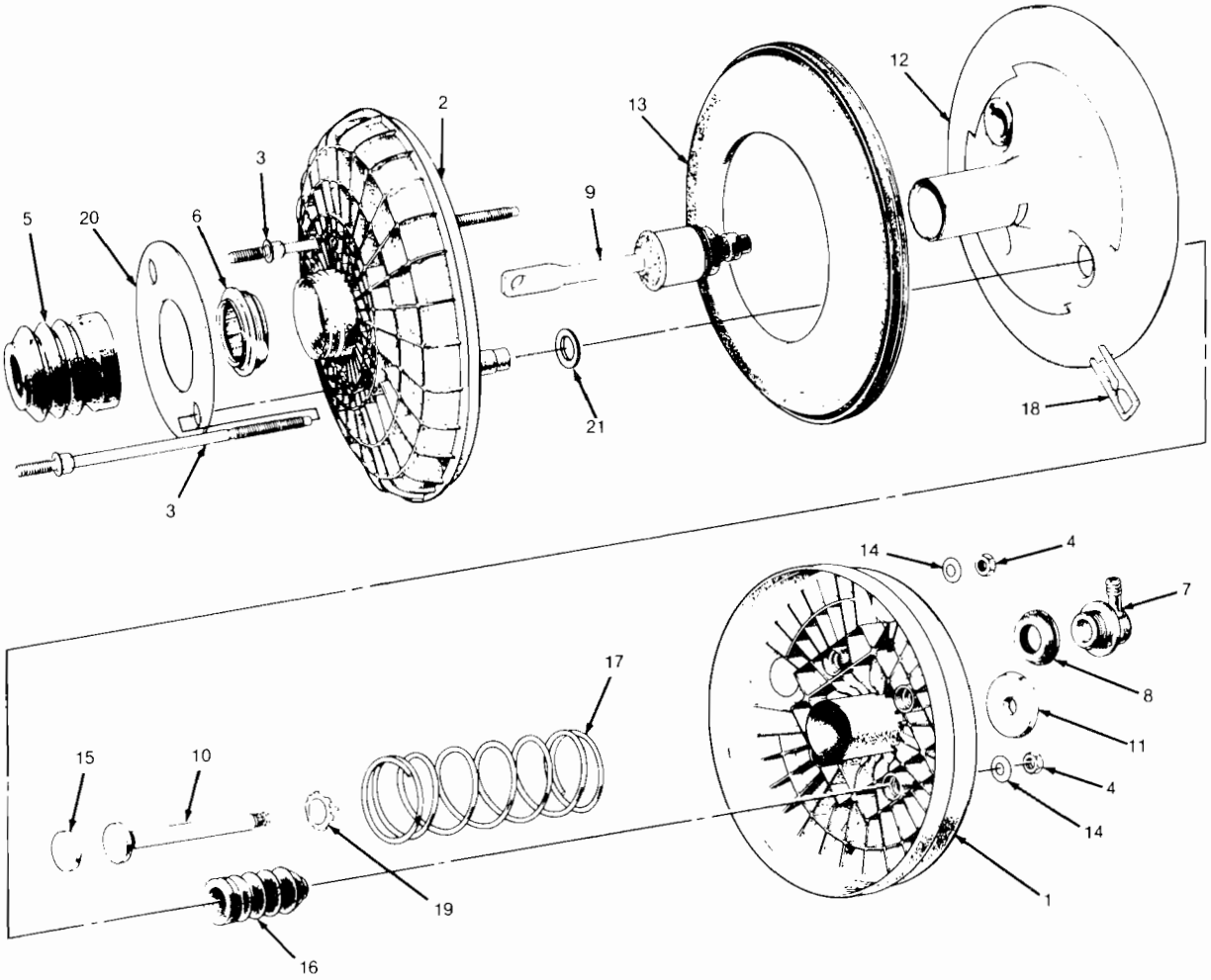
1. Lubricate OD of new valve assembly (9) with silicone grease and fit into vacuum piston (12). Retain valve assembly (9) by installing stop plate (18). Make sure stop plate (18) is fully installed to locked position.
2. Lubricate reaction disc (15) with silicone grease and install in vacuum piston.
3. Fit new tie rod boots (16) into holes in vacuum piston (12). Liberally coat insides of these boots with silicone grease.
4. Lubricate OD lip on diaphragm (13) with silicone grease and fit diaphragm (13) into vacuum piston (12).
5. Press new rear seal (6) into rear shell (12) and place washers (21) on tie rod posts. Lubricate ID of rear seal with silicone grease.
6. Install vacuum piston assembly (12) into rear shell (2). Push tie rod boots (16) over rear shell posts and locate diaphragm (13) bead around rear shell (2).
7. Install tie rods (3) in rear shell (2).
8. Position rear shell (2) with parts assembled thus far in fixture J-23456-51A.

   CAUTION: Do not attempt to adjust domed screw on output rod (10). This has been correctly set at the factory and should not be disturbed.
9. Install output rod (10) and new retainer (19) in vacuum piston (13). Lubricate output rod with silicone grease.
10. Fit new front seal (11) in front shell (1), metal face of seal facing out. Push seal into bottom.
11. Locate return spring (17) in mouth of vacuum piston (12).
12. Install front shell (1) on rear shell (2) and other assembled parts using care not to unseat bead of diaphragm (13).

    NOTICE: In the following step use only original or genuine GM replacement nuts (4).

13. Press shells (1 and 2) together by hand and install coned springs (14) and nuts (4). Make sure coned springs (14) are positioned as shown in A.
14. Uniformly tighten nuts (4) until shells (1 and 2) are 5 mm (0.20 in.) apart. Check that diaphragm is properly seated over rim of rear shell.
15. Tighten nuts (4) to obtain dimension shown in B using gage as shown. This dimension is measured across washer face on tie rod (3) and nut (4)—not across shell surfaces.
16. Lubricate grommet (8) and vacuum check valve (7) and install in front shell (1).
17. Install gasket (20) and boot (5) onto rear shell. Be sure boot locates over flange on rear seal (6).

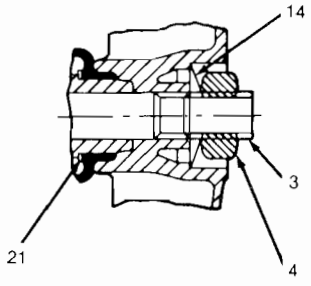
Figure 5D-2 Power Head Assembly 2 of 3



1. FRONT SHELL
2. REAR SHELL
3. TIE ROD
4. NUT
5. BOOT
6. REAR SEAL
7. VACUUM CHECK VALVE
8. GROMMET
9. VALVE ASSEMBLY
10. OUTPUT ROD
11. FRONT SEAL
12. VACUUM PISTON
13. DIAPHRAGM
14. CONED SPRING
15. REACTION DISC
16. TIE ROD BOOT
17. RETURN SPRING
18. STOP PLATE
19. RETAINER
20. GASKET
21. STEEL WASHER

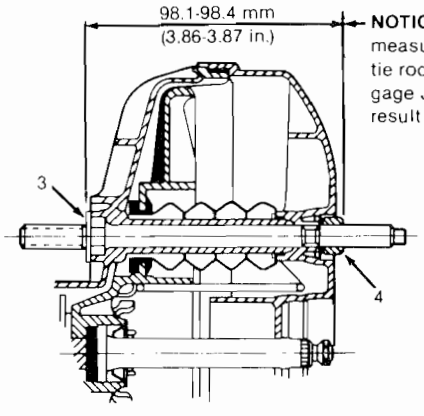
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A

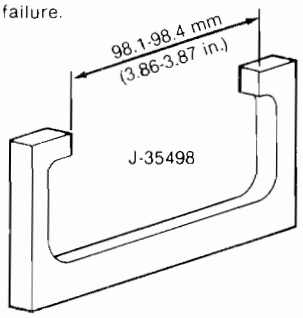


3. TIE ROD
4. NUT
14. CONED SPRING
21. STEEL WASHER

B



NOTICE: Dimension must be measured across washer face of tie rod (3) and nut (4). Failure to use gage J-35498 as specified may result in power head failure.



3. TIE ROD
4. NUT

DM4311E134

Figure 5D-3 Power Head Assembly 3 of 3

SECTION 5E

ANTI-LOCK BRAKE SYSTEM

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GENERAL DESCRIPTION

The function of the Anti-Lock Brake System (ABS) is to maintain vehicle steerability, directional stability, and optimum deceleration under severe braking conditions on most road surfaces. The ABS performs this function by monitoring the rotational speed of each vehicle wheel and controlling the brake line pressure to each wheel during a braking maneuver to prevent the braked wheels from locking. This action provides the driver with maximum vehicle controllability.

In conjunction with the conventional brake system, the ABS consists of:

- Modulator Valve
  (Valve - Brake Pressure Modulator)
- Control Module
  (Module - Electronic Brake Control)
- Lateral Acceleration Switch
- Four(4) Wheel Speed Sensors and Toothed Rings
- Wiring Harness and Relay
- Fuse

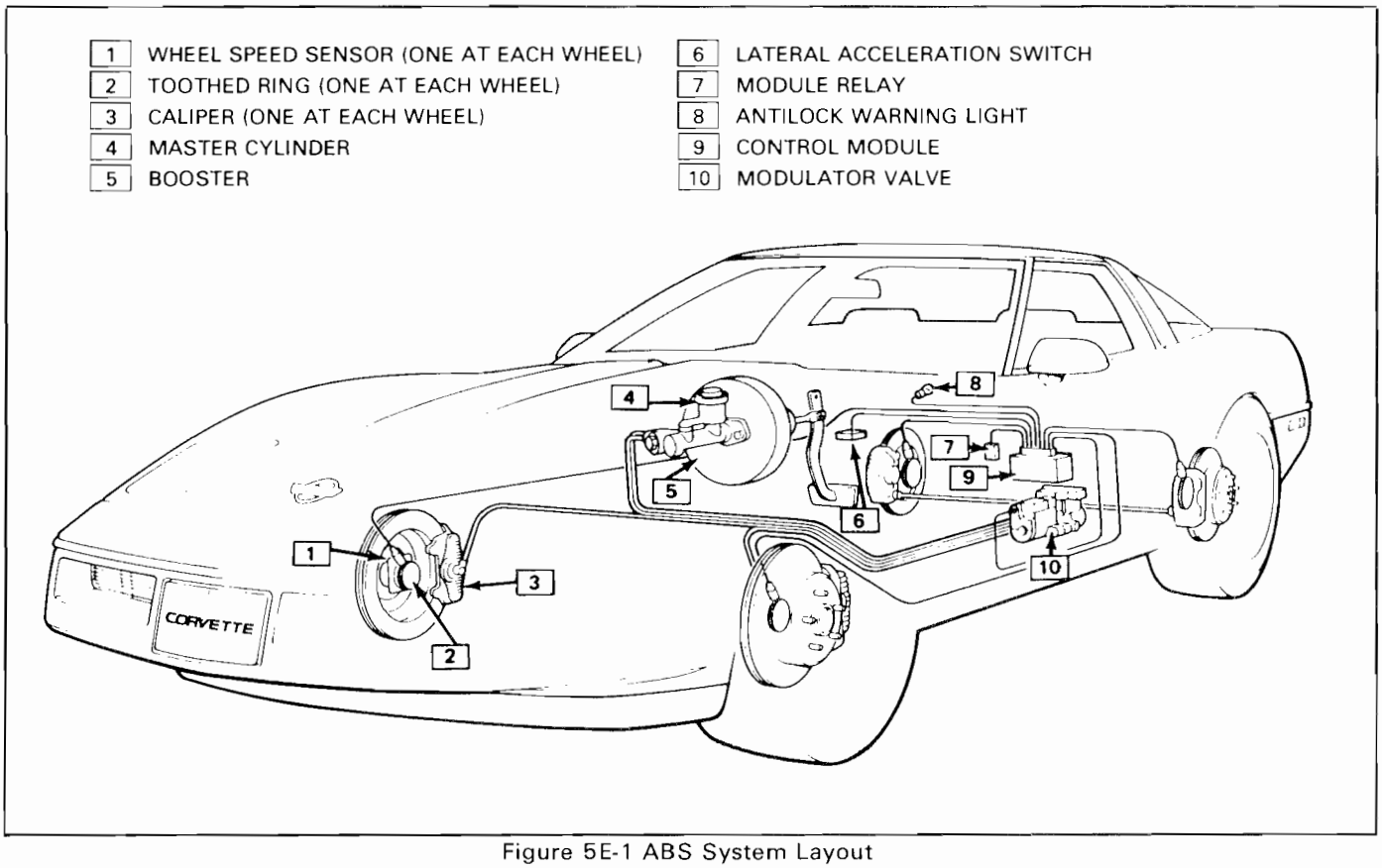
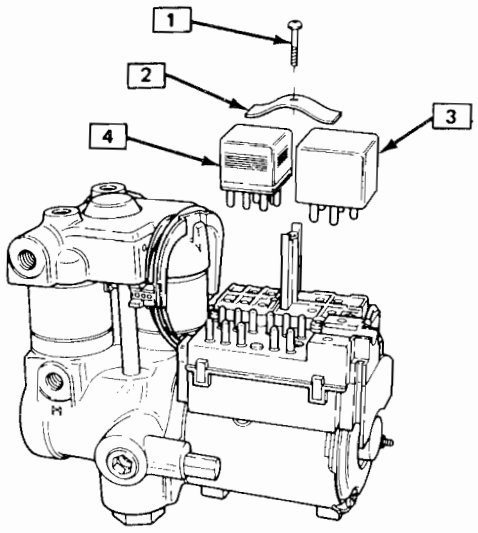


Figure 5E-1 ABS System Layout



1 SCREW
2 RETAINER
3 PUMP MOTOR RELAY
4 SOLENOID RELAY

Figure 5E-2 Modulator Valve

MODULATOR VALVE

Figure 5E-2

The modulator valve consists basically of three rapidly switching solenoid valves, two accumulator chambers - one for each brake circuit - and the return pump. One solenoid valve is assigned to the left and one to the right front wheel brake. The third solenoid valve is assigned to the rear wheel brakes. This layout is known as a "3-channel system". The modulator valve receives its instructions from the control module.

Independent of the pressure in the tandem master cylinder, the modulator valve can maintain or reduce the brake fluid pressure to the wheel brake cylinders during regulation. IT CANNOT INCREASE THE PRESSURE ABOVE THAT TRANSMITTED TO THE MASTER CYLINDER, AND CAN NEVER APPLY THE BRAKES BY ITSELF.

Two serviceable relays are mounted on top of the modulator valve that can be replaced. One controls the return pump and the other controls the power supply to the solenoid valves. The modulator valve is mounted in the rear storage compartment located behind the driver's seat. The modulator valve itself **CANNOT BE REPAIRED.**

NOTICE: If a problem occurs in the modulator valve, it **MUST** be replaced as an assembly.

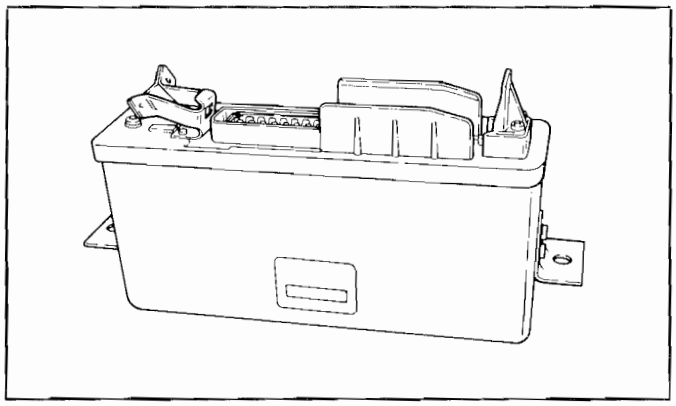


Figure 5E-3 Control Module

CONTROL MODULE

Figure 5E-3

The Control Module is constructed of two board plates. Components such as resistors, diodes, transistors and large integrated circuits are mounted on one side of the plates, and both sides have conductor paths. These integrated circuits (IC) contain thousands of transistors, resistors and diodes mounted on a single silicon chip. The plates are housed in the control module and surrounded by a light alloy casing.

Wheel acceleration, deceleration and slip values are calculated from the electric signals generated by the wheel speed sensors, which are proportional to tire/wheel speed. Logical manipulation of these values produces control commands for the electro-magnetically controlled hydraulic modulator valves.

The control module is located in the rear storage compartment behind the driver's seat. If the control module is determined to be at fault, it must be replaced as an assembly.

NOTICE: No repairs are permissible on the control module.

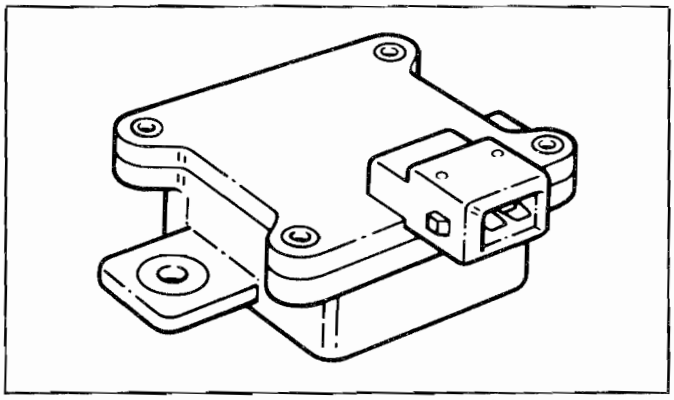


Figure 5E-4 Lateral Acceleration Switch

LATERAL ACCELERATION SWITCH

Figure 5E-4

The Lateral Acceleration Switch is basically two mercury switches connected in series. It is used to detect if the vehicle is cornering faster than a given curve speed. When this speed is exceeded, one of two(2)

mercury switches opens up and sends a signal to the control module.

The lateral accleration switch is located underneath the A/C control head on the floorpan. See Figure 5E-9.

NOTICE: The Lateral Acceleration Switch is not serviceable and can only be tested using the ABS TESTER.

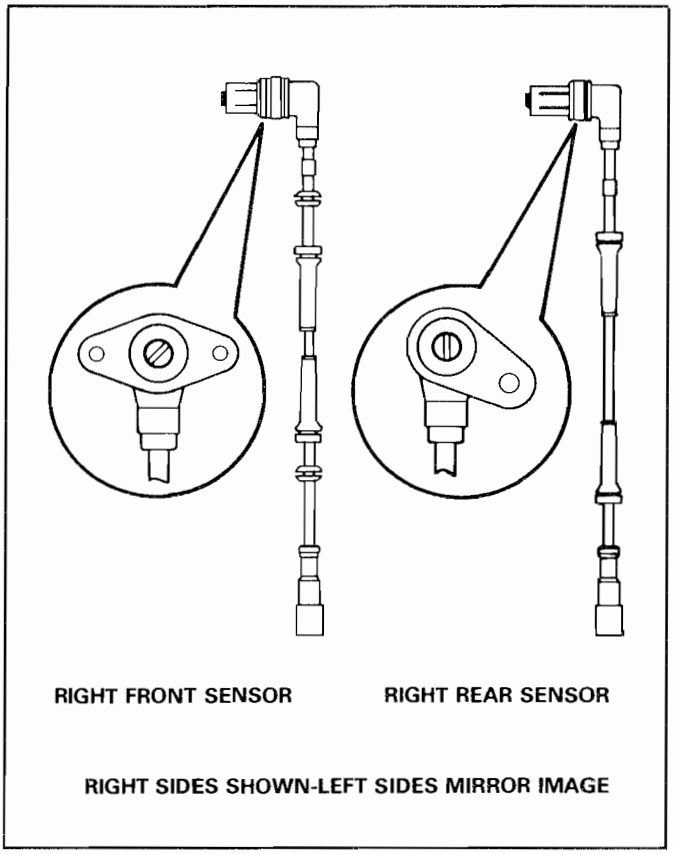


Figure 5E-5 Wheel Speed Sensors

WHEEL SPEED SENSORS

Figure 5E-5

The rotational speed of the wheels is detected by inductive wheel speed sensors, one at each wheel and the resulting electric signal is passed on to the control module. In this system with four wheel speed sensors, the rotational speed of **each wheel** is measured separately.

On the 3-channel system, the front wheels are controlled individually, the rear wheels together. The control of the rear wheels works on the "Select Low" principle. "Select Low" means that the wheel with the lower tire to road friction co-efficient, (i.e., the greater tendency to lock) determines the level of control.

The wheel speed sensors are installed in the knuckles. The toothed rings are pressed onto the front hub and bearing assemblies and the rear drive shaft spindles. The wheel speed sensors do **not** require adjustment.

NOTICE: No repairs or gap adjustments are permissible to the wheel speed sensors.

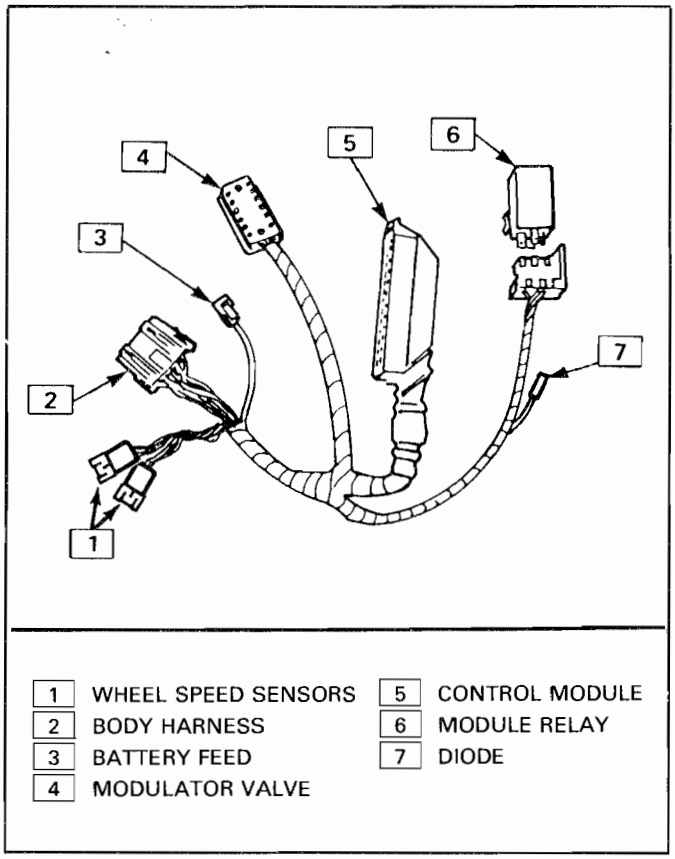


Figure 5E-6 Wiring Harness Connectors, Relay and Diode

WIRING HARNESS AND RELAY

Figure 5E-6

The wiring harness provides a path for the wheel speed sensors, lateral acceleration switch, power and stop light switch information to the control module and also outputs the current control to the modulator valve and ANTI LOCK warning lamp.

The ABS system has its own wiring harness, located in the rear storage compartment behind the driver's seat, which is connected to the standard wiring harness.

The module relay is installed in the circuit between the battery, fuse and the control module to protect the control module from damage due to possible excess spike voltage, (i.e., in the event of a defective alternator regulator).

FUSE

A fuse located in the main fuse panel, labeled BRAKE, provides protection for the main power feed circuit of the ABS electrical system. NOTE: The GAUGE fuse is also tied into the main power feed to the ABS.

OPERATION

When the ignition is switched on, the amber ANTI LOCK warning light in the instrument panel illuminates. When the engine is started, it goes out like the battery charge warning light. If the ABS warning light **does not** go out or comes on permanently while driving, indicates a fault in the ABS system.

Upon starting the vehicle, the control module performs a functional check of the electrical circuitry. The test cycle itself checks the components of the monitoring circuit as well as the logic section. For this purpose, the control module is fed with given test sample signals to check whether the correct output signals are available.

Since the ABS system may not be used everyday, there is an additional test which actually runs the modulator valve. This is done to insure that the system is functioning properly. Whenever the ignition is first turned on and the vehicle reaches 6 km/h (4 mph), the test starts. This can be heard and (if the driver's foot happens to be on the brake pedal) felt.

NOTE: This test is only done once each time the ignition is first turned on.

The system continuously monitors all components:

- Modulator Valve
- Control Module
- Lateral Acceleration Switch
- Wheel Speed Sensors
- Wiring Harness and Relays

The control module also constantly monitors its own supply voltage. If the supply voltage drops below a specified minimum value, ABS will be switched off and the amber ANTI LOCK light will come on. When the supply voltage returns to or exceeds the specified minimum value, the light will go off. If a fault occurs in ABS, the ANTI LOCK warning light comes on and ABS will be switched off. The system will remain off until the vehicle is restarted at which time the functional check is repeated. **The conventional brake system remains fully operational** provided it is not faulty.

DIAGNOSIS

When encountering an ABS malfunction, such as the amber ANTI LOCK warning light "ON", perform the following preliminary checks.

1. Check to see if the control module connector is securely connected.
2. Check to see that all ABS connectors are securely connected.
3. Check the BRAKE fuse.
4. Check the GAUGE fuse.

If the preliminary checks do not correct the malfunction, you must use J35890 ABS Tester to properly diagnose the system. Refer to Section 8A, Electrical Diagnosis, cell 44, for complete diagnostic information including use of J35890 ABS Tester, and J35592 Pinout Box.

ON-CAR SERVICE

NOTICE: The ABS is basically maintenance-free, but when performing work on ABS-equipped vehicles, the following precautions must be observed:

- If **welding work** is to be performed with an electric welding unit, the control module must be unplugged.
- During **painting work** , the control module may be subjected to a maximum of 95°C for brief periods and a maximum of 85°C for lengthy periods (approx. 2 hours).
- After **replacement of the modulator valve** , control module, wheel-speed sensors and wiring harness as well as work involving the ABS assemblies (i.e., work performed after accidents), **the entire ABS system must be checked using the ABS diagnostic tester.** Make absolutely sure that the brake lines are properly routed.
  NOTE: If the brake lines happen to get swapped (inlet vs. outlet), it can only be detected in one of two(2) ways: one being the ABS diagnostic tester or by doing an anti-lock stop, at which time the wheels will do just the opposite, namely lock-up.
- **Do not** use a fast charger for starting the engine.
- Disconnect the battery from the vehicle electrical system when fast charging.
- Never disconnect the battery from the vehicle electrical system with the engine running.
- Make sure that all connectors of the wiring harness are securely connected.
- Never connect or disconnect the wiring-harness plug of the control module with the ignition switched on.
- For safety reasons, **the modulator valve must not be repaired, but the complete unit must be replaced.** Exceptions to this are the pump motor relay and the solenoid relay. Both relays may be replaced. **No screws on the modulator valve may be loosened** apart from the brake-line connections. After loosening, it is no longer possible to get the brake circuits leak-tight.
- When replacing the modulator valve, it **must** be removed through the access in the rear storage compartment. Be sure to protect the vehicle interior/exterior to avoid damage from brake fluid spillage. **Do not** attempt to remove the bottom of the rear storage compartment to replace the modulator valve.
- Be sure to wipe out the bottom of the rear storage compartment when replacing the modulator valve.
- **Do not** support suspension components by the wheel speed sensor wires.
- The wheel speed sensors are a tight fit into the knuckle and are to be pushed in by hand. **Do not** hammer the sensors into position.
- There are four individual wheel speed sensors and **must** be installed in their respective locations. Each service wheel

speed sensor is identified with a white tag, (located 20mm from the neck of the sensor), labeled L (left) and R (right).

- Tire and wheel assemblies are to be removed when replacing wheel speed sensors.
- Wheel speed sensors must be given an anti-corrosion coating before installation to prevent galvanic corrosion. **Do not** use grease.
- The use of silicone brake fluid is **prohibited** .
- On convertible models, access to the ABS components in the left rear storage compartment is accomplished by removing the left rear speaker.
- Always note the routing, position, mounting, and locations of all the components, wiring, connectors, clips, brackets, brake lines, etc., when performing service on vehicles with ABS. Proper operation of the system can only be achieved if the system is restored to its original equipment condition.

The above notices are not exhaustive and are to be followed when working on ABS equipped vehicles. Become familiar with the ABS system and how it may be inter-related with other components on the vehicle, when performing service work.

MODULATOR VALVE

Figure 5E-7

Removal

1. Disconnect negative battery cable.
2. Remove storage tray and insulation.
3. Disconnect and remove the entire ABS wiring harness from the storage compartment. See Wiring Harness Removal.
4. Disconnect modulator valve ground from body harness.
5. Disconnect the 5 brake pipes from the modulator valve, note location for reassembly.
6. Loosen the 3 nuts securing the modulator valve to the bracket.

   NOTICE: When removing the modulator valve from the storage compartment, protect vehicle interior from possible brake fluid spillage.

7. Remove the modulator from the storage compartment.
8. Wipe out any brake fluid from the bottom of the storage compartment.

Installation

1. Transfer ground wire and insulators to new modulator valve.
2. Install modulator valve to the bracket and torque nuts to 10 N·m (7 lb. ft.).
3. Remove shipping caps from the modulator valve and connect brake pipes. Torque brake pipes to 18 N·m (13 lb. ft.).
4. Connect modulator valve ground.
5. Reinstall ABS wiring harness.

   NOTICE: When installing the ABS wiring harness, make sure that all connectors are securely connected.

6. Connect negative battery cable.
7. Bleed brakes, see Section 5.
8. Install insulation and storage tray.

CONTROL MODULE

Figure 5E-8

Removal

1. Disconnect negative battery cable.
2. Remove storage tray and insulation.
3. Disconnect control module connector by depressing spring clip located under the neck of the connector.
4. Remove module relay from control module bracket.
5. Remove 2 control module mounting bolts.
6. Remove control module.

Installation

Reverse removal procedure.

NOTICE: The control module must be reinstalled properly to insure the wiring harness connector comes in from the correct side. See Figure 5E-11. Control module connector must be securely connected.

LATERAL ACCELERATION SWITCH

Figure 5E-9

Removal

1. Disconnect negative battery cable.
2. Remove the screws retaining trim plate for the instrument cluster.
3. Remove the screws retaining I.P. accessory trim plate and then remove the trim plate.
4. Remove the screws retaining console trim plate.
5. Rotate trimplate and disconnect lighter.
6. Remove A/C control head.
7. Remove lateral acceleration switch mounting bolts.
8. Disconnect wiring harness and remove lateral acceleration switch.

Installation

Reverse removal procedure.

WHEEL SPEED SENSOR-FRONT OR REAR

Figure 5E-10

Removal

1. Raise vehicle
2. Remove tire and wheel assembly.
3. Unclip sensor connector from bracket and disconnect.
4. Remove sensor wire grommets from brackets, note sensor wire routing for installation.

5. Remove sensor hold down bolt(s) from knuckle.
6. Remove sensor.

Installation

1. Coat new wheel speed sensor with anti-corrosion compound prior to installation.
2. Install sensor into knuckle.

NOTICE: Do not hammer sensor into knuckle.

3. Install sensor hold down bolt(s) and torque to 3 N·m (27 lb. in.).
4. Install sensor wire grommets to brackets and route sensor wire as noted during removal.
5. Connect sensor connector and clip into bracket.
6. Install tire and wheel assembly.
7. Lower vehicle.

WIRING HARNESS

Figures 5E-6 and 5E-11

Removal

1. Disconnect negative battery cable.
2. Remove storage tray and insulation.
3. Disconnect the following wiring harness connectors:
   - Control Module - depress spring clip located under the neck of the connector and remove.
   - Modulator Valve - remove 2 screws from harness retainer and remove connector.
   - Battery Feed - disconnect 12 guage red wire.
   - Wheel Speed Sensor - disconnect
   - Body Harness - disconnect
   - Module Relay - remove module relay from control module bracket and disconnect.

Installation

Reverse removal procedure.

NOTICE: When installing harness, make sure that all connectors of the wiring harness are securely connected.

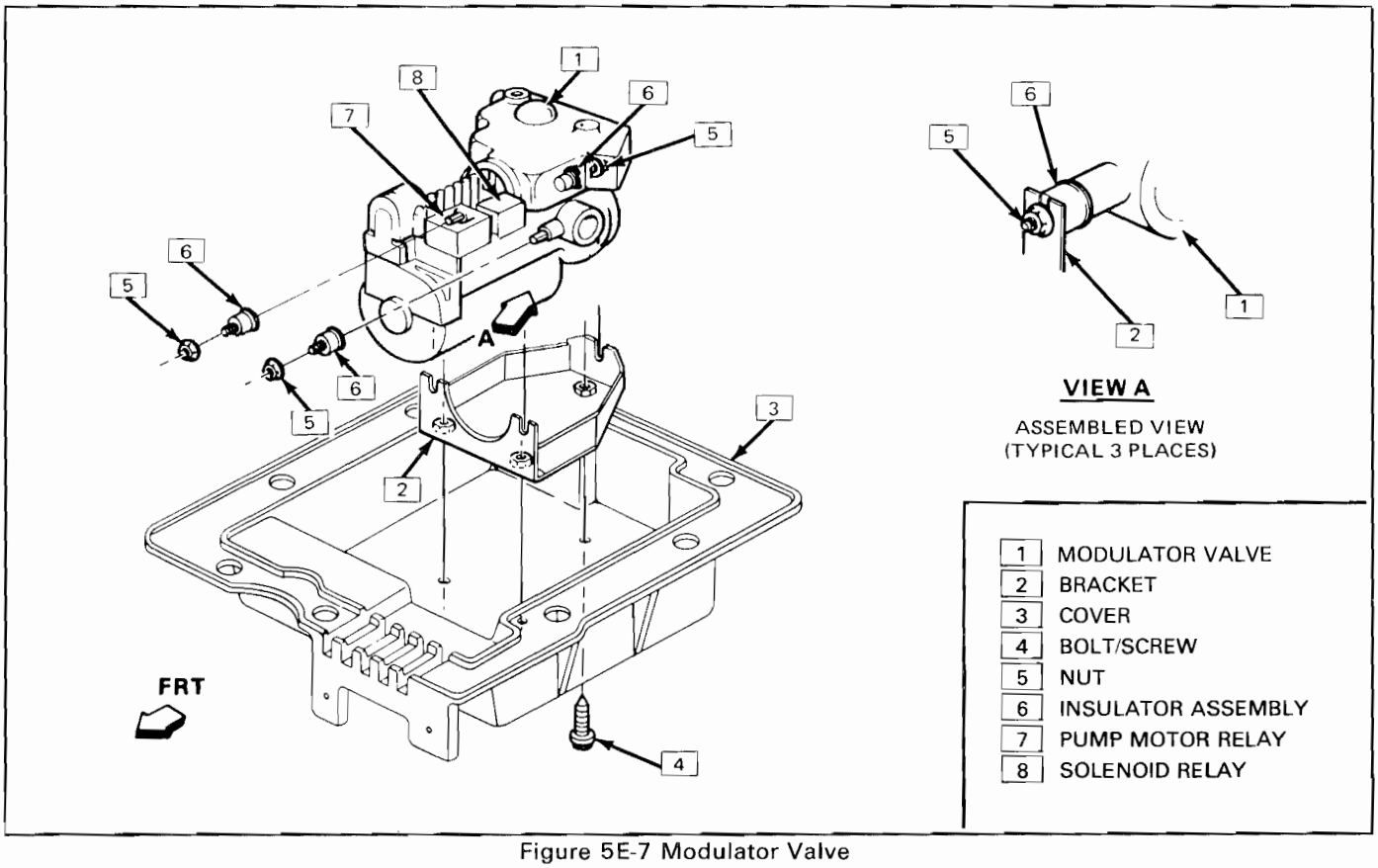


Figure 5E-7 Modulator Valve

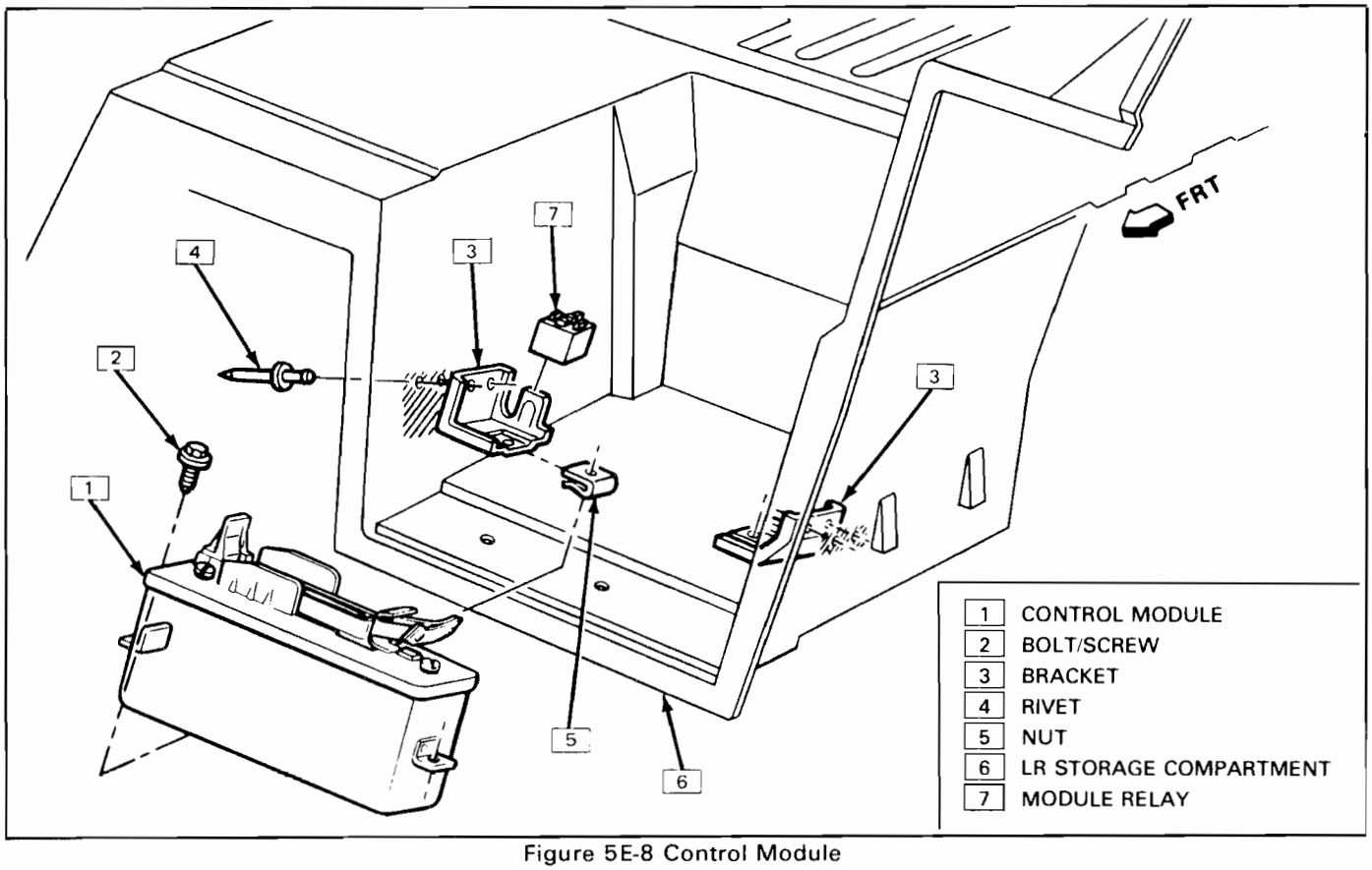


Figure 5E-8 Control Module

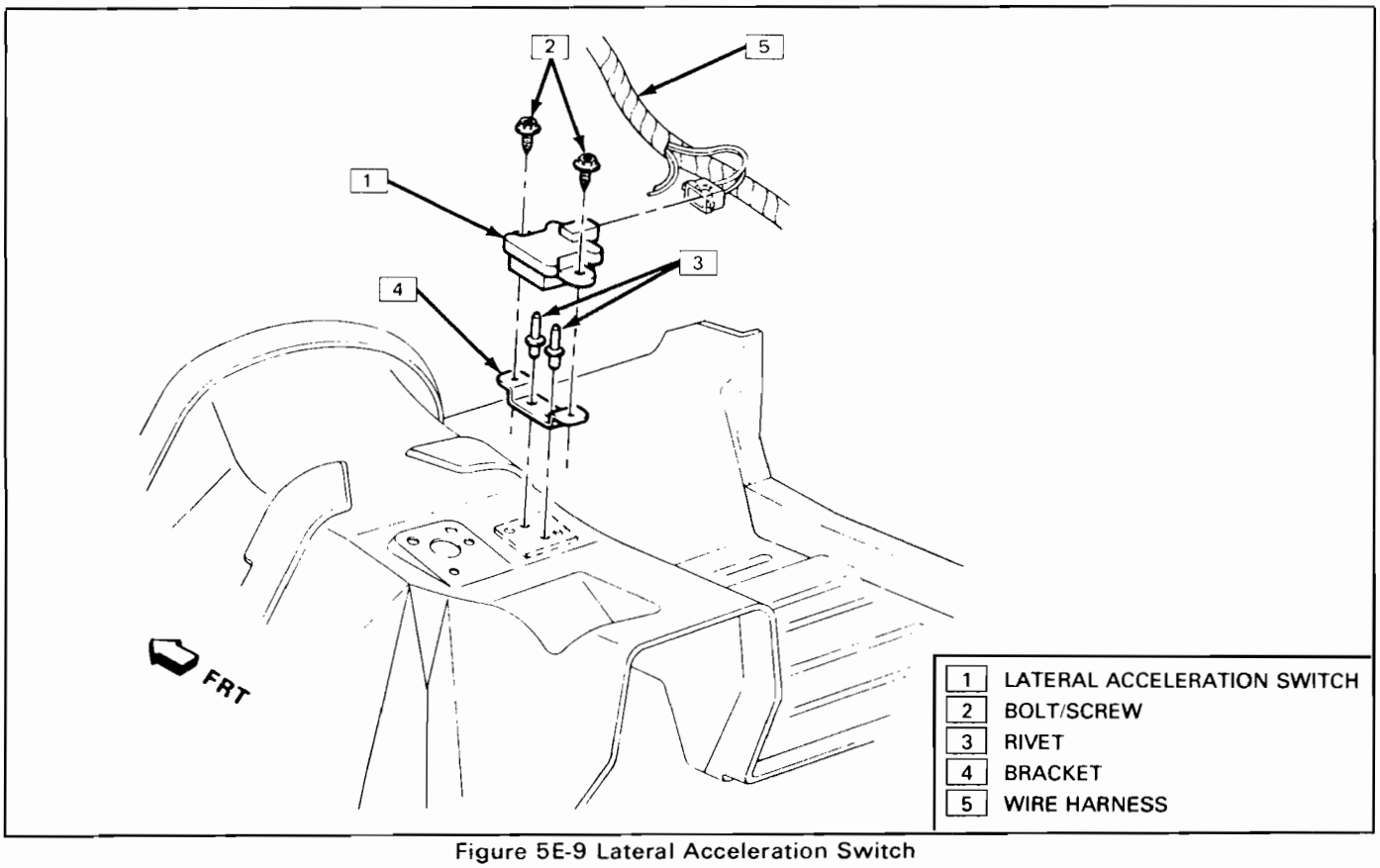
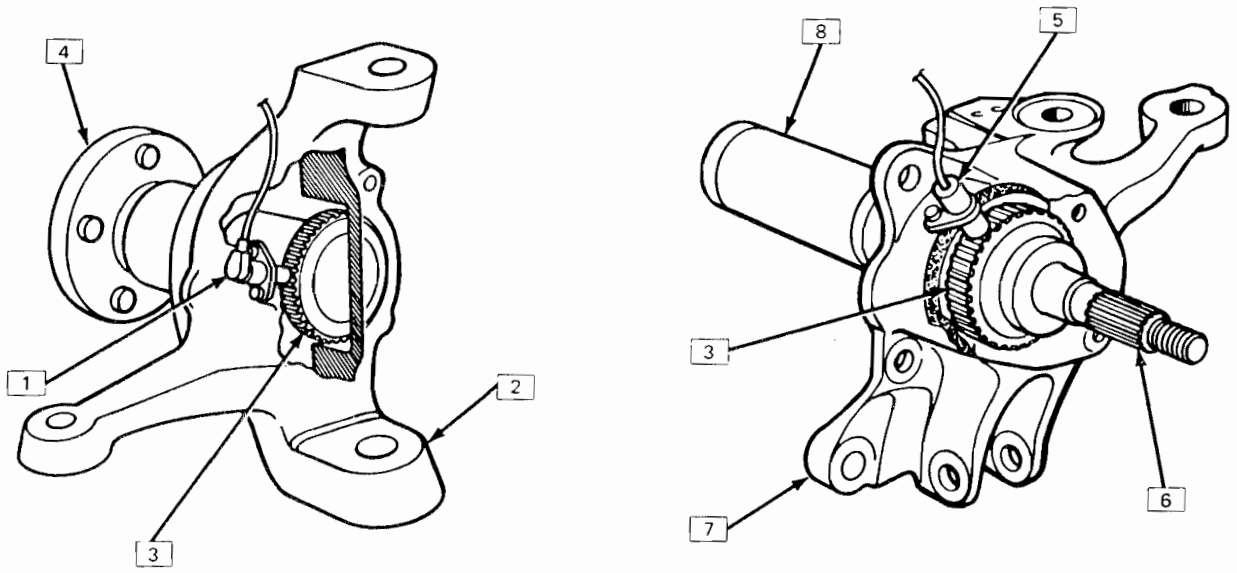


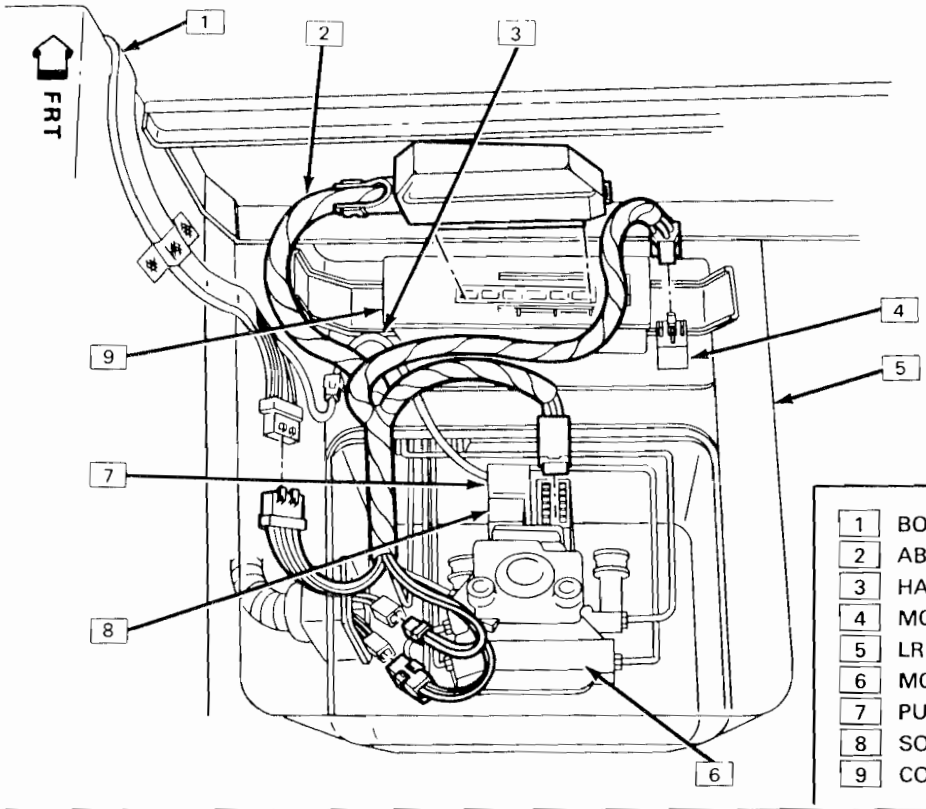
Figure 5E-9 Lateral Acceleration Switch



LEFT SIDES SHOWN RIGHT SIDES TYPICAL

1 FRONT SENSOR	5 REAR SENSOR
2 FRONT KNUCKLE	6 REAR DRIVE SHAFT SPINDLE
3 TOOTHED RING (PART OF 4 & 6)	7 REAR KNUCKLE
4 FRONT HUB & BEARING ASSEMBLY	8 REAR DRIVE SHAFT

Figure 5E-10 Wheel Speed Sensors



1	BODY HARNESS
2	ABS HARNESS
3	HARNESS GROUND
4	MODULE RELAY
5	LR STORAGE COMPARTMENT
6	MODULATOR VALVE
7	PUMP MOTOR RELAY (PART OF 6)
8	SOLENOID RELAY (PART OF 6)
9	CONTROL MODULE

Figure 5E-11 Wiring Harness and Relays

GENERAL SPECIFICATIONS

FRONT DISC BRAKES	292mm x 19.9mm (11.5" x .780")
Disc - Minimum Refinish Thickness	18.4mm (.724")
Facing Material	Semi Metallic
Facing Attachment	Bonded
REAR BRAKES	292mm x 19.9mm (11.5" x .780")
Disc - Minimum Refinish Thickness	18.4mm (.724")
Facing Material	Semi Metallic
Facing Attachment	Bonded
MASTER CYLINDER w/Integral Proportioning Valve	
Piston Diameter	22.2mm (.875)
Vacuum Brake Booster	
Size	250mm (9.8")

TORQUE SPECIFICATIONS

Master Cylinder to Booster	21 N·m (15 ft. lbs.)
Vacuum Booster to Dash	21 N·m (15 ft. lbs.)
Brake Line Nuts (to Master Cyl. and Valves)	18 N•m (13 ft. lbs.)
Brake Line Nuts (to Front Brake Hose)	18 N•m (13 ft. lbs.)
Brake Line Nut (to Rear Brake Hose)	18 N•m (13 ft. lbs.)
Brake Line Clip-to-Frame Or Underbody	6 N·m (4 ft. lbs.)
Brake Bleeder Valves	9 N·m (7 ft. lbs.)
Caliper Mounting Bracket Bolt	
(Front Disc Brakes)	180 N·m (133 ft. lbs.)
(Rear Disc Brakes)	95 N·m (70 ft. lbs.)
15mm Caliper Pin Bolt (Front and Rear)	32 N·m (24 ft. lbs.)
Brake Hose to Caliper	44 N·m (32 ft. lbs.)
Brake Pedal Pivot Nut	30 N·m (22 ft. lbs.)
Rear Cable Bracket	47 N·m (35 ft. lbs.)
Front and Rear Brake Shield	10 N·m (7 ft. lbs.)
Wheel Hub to Steering Knuckle Nut	62 N·m (46 ft. lbs.)
Stoplight Switch Bracket to Brake Pedal Support	4.5 N·m (3 ft. lbs.)
Stoplight Switch Actuator to Brake Pedal Arm	24 N·m (18 ft. lbs.)

SECTION 6

GENERAL INFORMATION - ENGINE

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ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR PURPOSES OF SERVICING THE PRODUCT MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

DESCRIPTION OF SECTION 6

SECTION 6A1 - ENGINE MECHANICAL

This section contains information on the mechanical parts of the engine, such as block, crankshaft, pistons, valve train, and camshaft. Overhaul procedures, removal and replacement procedures, and specifications are also covered.

SECTION 6B - ENGINE COOLING

Engine cooling system components such as radiator, water pump, thermostat, and cooling fan, are covered in this section. Accessory drive belts are also covered, along with cooling system capacities.

SECTION 6C - FUEL SYSTEM

This section contains information on all the parts of the fuel system **except** the port fuel injection itself. Items covered are fuel tank, fuel pump, and fuel lines.

SECTION 6D - ENGINE ELECTRICAL

Items covered in this section are battery, generator, starter, distributor, engine wire harness, spark plugs and wires, and ignition switch.

SECTION 6E3 - DRIVEABILITY AND EMISSIONS FUEL INJECTION (PFI)

This section covers emission control systems general information, diagnostic procedures and On-Car Service which will lead to repairing performance and driveability related problems. All emission components are covered, as well as all removal and replacement procedures. Instructions on use of special tools are also given.

SECTION 6F - EXHAUST SYSTEM

This section has information on all exhaust system parts, such as tailpipes, mufflers, and the catalytic converter.

GENERAL INFORMTAION

CLEANLINESS AND CARE

An automobile engine is a combination of many machined, hones, polished and lapped surfaces with tolerances that are measured in the ten thousands of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surfaces on initial operation. Throughout this section, it should be understood that proper cleaning and protection of machines surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever valve train components are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.

Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.

GENERAL INFORMATION ON ENGINE SERVICE

THE FOLLOWING INFORMATION ON ENGINE SERVICE SHOULD BE NOTED CAREFULLY, AS IT IS IMPORTANT IN PREVENTING DAMAGE AND IN CONTRIBUTING TO RELIABLE ENGINE PERFORMANCE.

When raising or supporting the engine for any reason, do not use a jack under the oil pan. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen resulting in a damaged oil pickup unit.

It should be kept in mind, while working on the engine, that the 12-volt electrical system is capable of damaging short circuits. When performing any work where electrical terminals could possibly be grounded, the ground cable of the battery should be disconnected at the battery.

Any time the port fuel injection assembly or air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

IN THE MECHANICAL PROCEDURES DESCRIBED IN THIS SECTION, GENERALLY NO REFERENCES WILL BE MADE TO THE REMOVAL OF OPTIONAL EQUIPMENT SUCH AS POWER STEERING PUMP, AIR CONDITIONING COMPRESSOR, ETC. SHOULD IT BECOME NECESSARY TO REMOVE ANY SUCH ITEM TO PERFORM OTHER SERVICE, REFER TO THE APPROPRIATE SECTION OF THIS SERVICE MANUAL FOR SPECIFIC INFORMATION.

ENGINE MECHANICAL DIAGNOSIS

The following diagnostic information covers common problems and possible causes. When the proper diagnosis is made, the problem should be corrected by adjustment, repair or part replacement as required. Refer to the appropriate section of the manual for these procedures.

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive Oil Loss	a. External oil leaks.	1. Tighten bolts and/or replace gaskets and seals as necessary.
	b. Improper reading of	1. Check oil with car on a level surface and allow adequate drain down time.
	c. Improper oil viscosity.	1. Use recommended S.A.E. viscosity for prevailing temperatures.
	d. Continuous high speed driving and/or severe usage such as trailer hauling.	1. Continuous high speed operation and/or severe usage will normally cause decreased oil mileage.
	e. Crankcase ventilation, PCV system malfunctioning.	1. Service as necessary.
	f. Valve guides and/or valve stem seals worn, or seals omitted. seals.	1. Ream guides and install oversize service valves and/or new valve stem

	g. Piston rings not seated, broken or worn.	1. Allow adequate time for rings to seat. 2. Replace broken or worn rings as necessary.
	h. Piston improperly installed or misfitted.	1. Replace piston or repair as necessary.
Low Oil Pressure	a. Slow idle speed.	1. Set idle speed to specs.
	b. Incorrect or malfunctioning oil pressure switch.	1. Replace with proper switch
	c. Incorrect or malfunctioning oil pressure gage.	1. Replace with proper gage.
	d. Improper oil viscosity or diluted oil.	1. Install oil of proper viscosity for expected temperature. 2. Install new oil of diluted with moisture or unburned fuel mixtures.
	e. Oil pump worn or dirty.	1. Clean pump and replace worn parts as necessary.
	f. Plugged oil filter.	1. Replace filter and oil.
	g. Oil pickup screen loose or plugged.	1. Clean or replace screen as necessary.
	h. Hole in oil pickup tube.	1. Replace tube.
	i. Excessive bearing clearance.	1. Replace as necessary.
	j. Cracked, porous or plugged oil galleys.	1. Repair or replace block.
	k. Galley plugs missing or mis-installed.	1. Install plugs or repair as necessary.
Valve Train Noise	a. Low oil pressure.	1. Repair as necessary. (See diagnosis for low oil pressure.)
	b. Loose rocker arm attachments.	1. Inspect and repair necessary.
	c. Worn rocker arm and/or pushrod.	1. Replace as necessary.
	d. Broken valve spring.	1. Replace spring.
	e. Sticking valves.	1. Free valves.

	f. Lifers worn, dirty or defective.	1. Clean, inspect test and replace as necessary.
	g. Camshaft worn or poor machining.	1. Replace camshaft.
	h. Worn valve guides.	1. Repair as necessary.

ENGINE KNOCK DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine knocks cold and continues for two to three minutes. Knock increases with torque.	a. EFE equipped engines may have valve knock.	1. Replace EFE valve.
	b. Flywheel contacting splash shield.	1. Reposition splash shield.
	c. Loose or broken balancer or drive pulleys.	1. Tighten or replace as necessary.
	d. Excessive piston to bore clearance.	1. Replace piston.
	e. Bent Connecting rod.	1. Replace bent connecting rod.
Engine has heavy knock hot with torque applied.	a. Broken balancer or pulley hub.	1. Replace parts as necessary.
	b. Loose torque converter bolts.	1. Tighten bolts.
	c. Exhaust system grounded.	1. Reposition as necessary.
	d. Flywheel cracked or loose rivets on flywheel.	1. Replace flywheel.
	e. Excessive main bearing clearance.	1. Replace as necessary.
	f. Excessive rod bearing clearance.	1. Replace as necessary.
Engine has light knock hot in light load conditions.	a. Detonation or spark knock.	1. EST or ESC (See Section 6D or 6E). Check engine timing and fuel quality.
	b. Loose torque converter bolts.	1. Tighten bolts.

	c. Exhaust leak at manifold.	1. Tighten bolts and/or replace gasket.
	d. Excessive rod bearing clearance.	1. Replace bearings as necessary.
Engine knocks on initial start up but only lasts a few seconds.	a. Improper oil viscosity.	1. Install proper oil viscosity for expected temperatures.
	b. Hydraulic lifter bleed down.	1. Clean, test and replace as necessary.
	c. Excessive crankshaft end clearance.	1. Replace crankshaft thrust bearing.
	d. Excessive main bearing clearance.	1. Replace worn parts.
Engine knocks at idle hot.	a. Compressor or generator bearing.	1. Replace as necessary.
	b. Valve train.	1. Replace parts as necessary.
	c. Improper oil viscosity.	1. Install proper viscosity oil for expected temperature.
	d. Excessive piston pin clearance.	1. Ream and install oversize pins.
	e. Connecting rod alignment.	1. Check and replace rods as necessary.
	f. Insufficient piston to bore clearance.	1. Hone and fit new piston.
	g. Loose crankshaft balancer.	1. Torqure any or replace worn parts.

ENGINE COMPRESSION TEST

1. Disconnect the "BAT" terminal and the 4 terminal connector from the HEI distributor.
2. When checking cylinder compression, the throttle should be open, all spark plugs removed, and the battery at or near full charge. The lowest reading cylinder should not be less than 70% of the highest and no cylinder reading should be less than 100 pounds.

This should be done with four "puffs" per cylinder.

- Normal - Compression builds up quickly and evenly to specified compression on each cylinder.
- Piston Rings Leaking - Compression low on first stroke. Tends to build up on following strokes but does not reach normal. Improves considerably with addition of oil.
- Valves Leaking - Low on first stroke. Does not tend to build up on following strokes. Does not improve much with addition of oil.

Use approximately three squirts from a plunger-type oiler.

5.7 LITER V8 VIN CODE 8 (L98)

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GENERAL DESCRIPTION

CYLINDER BLOCK

The cylinder block is made of cast iron and has 8 cylinders arranged in a "V" shape with 4 cylinders in each bank. Five main bearings support the crankshaft which is retained by bearing caps that are machined with the block for proper alignment and clearnances. Cylinders are completely encircled by coolant jackets.

CYLINDER HEAD

The aluminum cylinder heads have individual intake and exhaust ports for each cylinder. The valve guides and valve seats are pressed-in inserts. The rocker arms are retained on threaded in rocker studs and the push rod guide plates are held in place by the rocker studs.

CRANKSHAFT AND BEARINGS

The crankshaft is cast nodular iron and is supported by five main bearings. Number five is the end thrust bearing.

Main bearings are lubricated from oil holes which intersect the camshaft bearings. The camshaft bearings are fed oil by the main oil gallery which is rifle drilled down the center of the block, above the camshaft. Two additional oil gallerys are on either side of the main oil gallery to provide an oil supply for the hydraulic lifters.

CAMSHAFT AND DRIVE

The cast iron camshaft is supported by five bearings and is chain driven. A steel crankshaft sprocket drives the timing chain which in turn drives the camshaft through a cast iron sprocket. Cam lobes are ground, hardened and tapered with the high side toward the rear. This, coupled with a spherical face on the lifter, causes the valve lifters to rotate.

Camshaft bearings are lubricated through oil holes which intersect the main oil gallery. The main oil gallery is rifle drilled down the center of the block, above the camshaft.

PISTONS AND CONNECTING RODS

The pistons are made of cast aluminum alloy using two compression rings and one oil control ring. Pins are Chromium steel and have a floating fit in the pistons They are retained in the connecting rods by a press fit.

Connecting rods are made of forged steel.

Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal.

VALVE TRAIN

A very simple ball pivot-type train is used. Motion is transmitted from the camshaft through the hydraulic lifter and push rod to the rocker arm. The rocker arm pivots on its ball and transmits the camshaft motion to the valve. The rocker-arm ball is retained by a nut.

HYDRAULIC VALVE LIFTERS

Hydraulic Valve Lifters are used to keep all parts of the valve train in constant contact.

The hydraulic roller lifter assembly consists of: a roller, the lifter body, which rides in the cylinder block boss, a plunger, a push rod seat, a metering valve, a plunger spring, a check ball and spring, a check ball retainer and a push rod seat retainer.

Oil is supplied to the lifter through a hole in the side of the lifter body which indexes with a groove and hole in the lifter plunger. Oil is then metered past the

oil metering valve in the lifter, through the pushrods to the rocker arms.

When the lifter begins to roll up the cam lobe, the ball check is held against its seat in the plunger by the ball check spring which traps the oil in the base of the lifter body below the plunger. The plunger and lifter body then raise a unit, pushing up the pushrod to open the valve. The force of the valve spring which is exerted on the plunger through the rocker arm and pushrod causes a slight amount of leakage between the plunger and lifter body. This "leak-down" allows a slow escape of trapped oil in the base of the lifter body. As the lifter rolls down the other side of the cam lobe and reaches the base circle of "valve closed" position, the plunger spring quickly moves the plunger back (up) to its original position. This movement causes the ball check to open against the ball spring and oil from within the plunger is drawn into the base of the lifter. This restores the lifter to zero lash.

EXHAUST MANIFOLDS

Tubular stainless steel exhaust manifolds are used to direct exhaust gases from the combustion chambers to the exhaust system.

COMBUSTION CHAMBERS

Combustion Chambers are cast to insure uniform shape for all cylinders. Spark plugs are located between the intake and exhaust valves.

The contoured wedge shape of the combustion chamber minimizes the possibility of detonation, facilitates breathing and provides swirling turbulence for smooth, complete combustion.

ENGINE LUBRICATION

Full pressure lubrication through a full flow oil filter, is furnished by a gear-type oil pump. The distributor, driven by a helical gear on the camshaft, drives the oil pump. The main oil gallery feeds oil, through drilled passages, to the camshaft and crankshaft to lubricate the bearings. The valve lifter oil gallery feeds the valve lifters which, through hollow push rods, feed the individually mounted rocker arms (Figure 6A1-1).

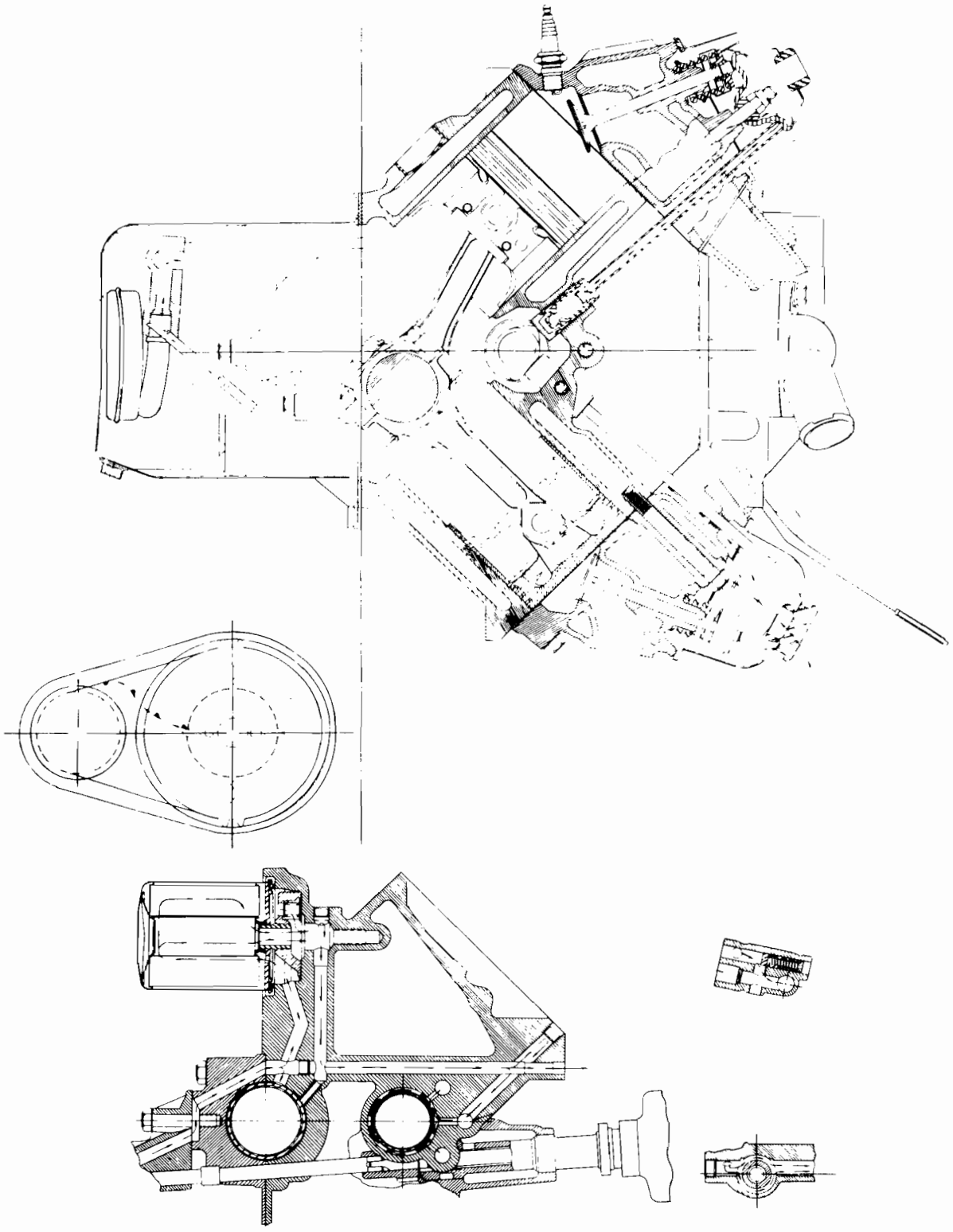


Figure 6A1-1 Engine Lubrication

ON VEHICLE SERVICE

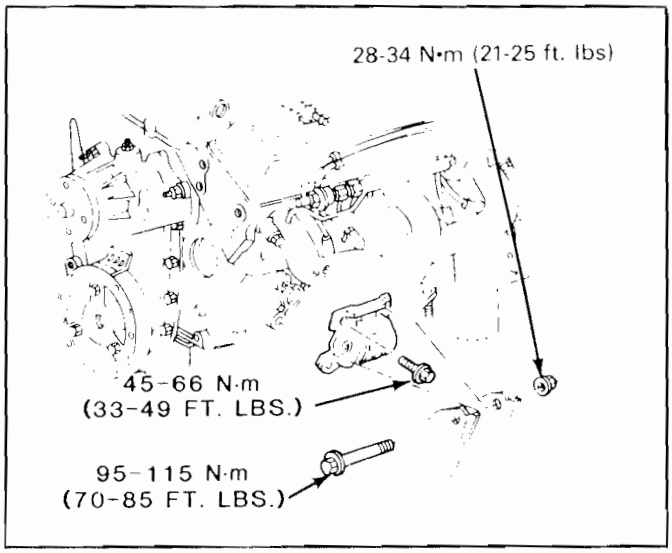


Figure 6A1-2 Engine Mount

ENGINE MOUNTS

Engine mounts (Figure 6A1-2) are the non-adjustable type and seldom require service. Broken or deteriorated mounts should be replaced immediately, because of the added strain placed on other mounts and drive line components.

Checking Engine Mounts

Front Mount

Raise the engine to remove weight from the mounts and to place a slight tension in the rubber. Observe both mounts while raising engine. If an engine mount exhibits:

a. Hard rubber surface covered with heat check cracks;
b. Rubber separated from a metal plate of the mount;
c. Rubber split through center, replace the mount.

If there is relative movement between a metal plate of the mount and its attaching points, lower the engine on the mounts and tighten the screws or nuts attaching the mount to the engine, frame, or bracket.

Front Mount Replacement (Right)

1. Disconnect battery negative cable.
2. Raise vehicle.
3. Remove engine mount through bolt.
4. Disconnect catalytic converter AIR pipe at exhaust manifold.
5. Disconnect catalytic converter AIR pipe at exhaust pipe.
6. Disconnect AIR pipe at converter.
7. Raise engine only enough for sufficient clearance.
8. Remove motor mount bolts.
9. Remove mount.
10. Replace mount to engine and lower engine into place.
11. Install retaining bolts and torque to specifications.
12. Reverse remaining removal procedures for installation.

Front Mount Replalcement (Left)

1. Disconnect battery negative cable.
2. Raise vehicle.
3. Remove engine mount through bolt.
4. Raise engine only enough for sufficient clearance.
5. Remove engine mount to block bolts.
6. Remove one exhaust manifold shroud screw.
7. Remove mount.
8. Replace mount to engine and lower engine into place.
9. Install retaining bolts and torque to specifications.
10. Reverse remaining removal procedures for installation.

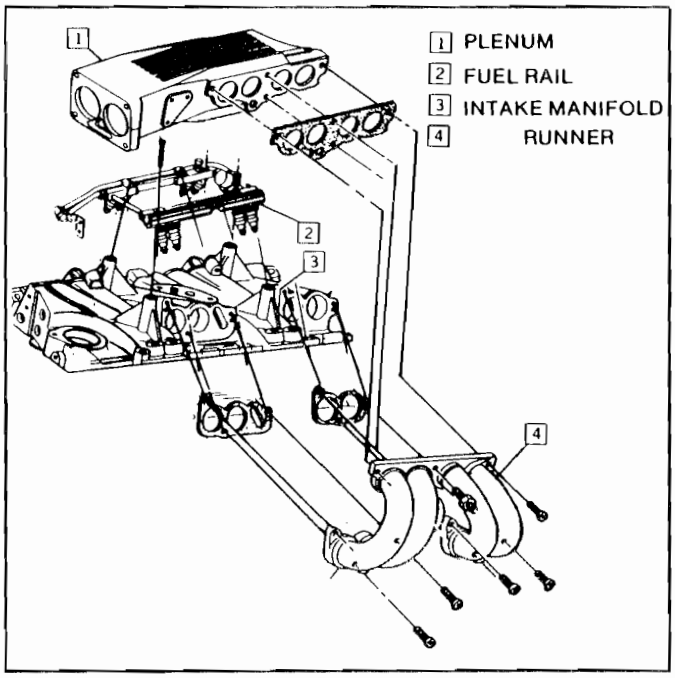


Figure 6A1-3 PFI Assembly

INTAKE MANIFOLD

Removal

1. Disconnect battery negative cable.
2. Drain cooling system.
3. Refer to Section 6E3 for PFI sub-assembly removal of:
   - Mass Air Flow Sensor
   - Plenum
   - Runners
   - Fuel Rail
4. Disconnect necessary vacuum hoses.
5. Disconnect necessary electrical connection.
6. Remove distributor cap.
7. Mark distributor and remove distributor.

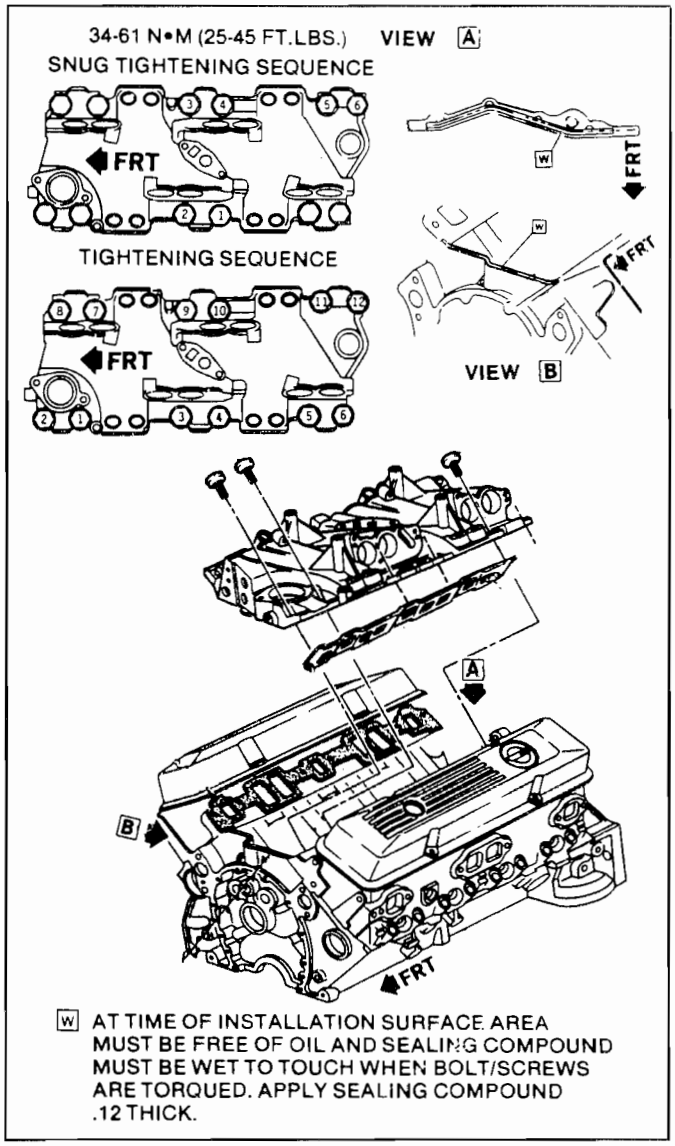


Figure 6A1-4 Intake Manifold Installation

8. Disconnect upper radiator hose at theromstat outlet.
9. Remove AIR pump brace.
10. Disconnect EGR pipe at intake.
11. Disconnect heater control vacuum line at intake.
12. Remove thermostat outlet.
14. Remove intake bolts.
15. Remove intake.

Installation

1. Clean gasket and seal surfaces on manifold, block, and cylinder heads with degreaser. Remove old RTV that is loose or will cause installation interference.
2. Install gaskets on cylinder heads, blocked openings in gaskets to be postioned at rear of engine. Bend gasket tab flush with rear face of cylinder head and place a 3/16″ (5mm) bead of RTV, #1052915 or equivalent, on the front and rear ridges of the cylinder case. Apply Loctite #1052624 or equivalent to attaching bolts.
3. Reverse removal procedures.

DIPSTICK TUBE

Removal

1. Disconnect battery negative cable to prevent possible contact of the dipstick tube with the battery terminal on starter during removal.
2. Remove bolt attaching bracket to engine and remove tube (loose fit).

Installation

1. Clean tube and apply sealant #1052080 or equivalent, around tube 1/2″ below bead.
2. Insert tube in block and rotate into position.
3. Install bolt (with starter brace on top of tube bracket) and connect battery cable.

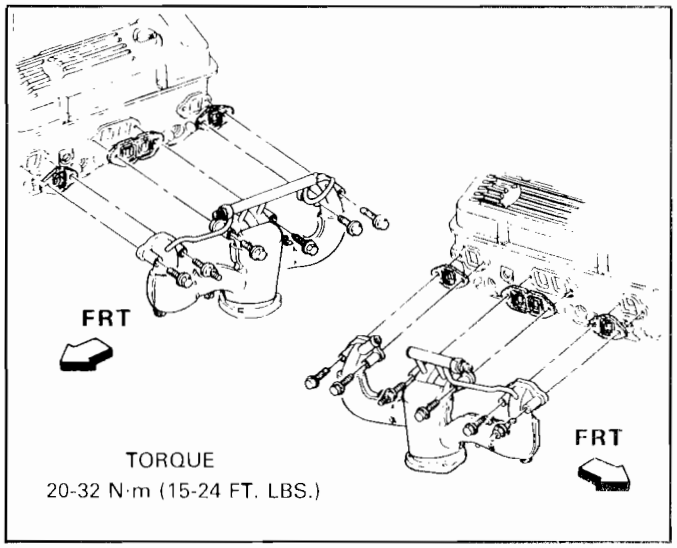


Figure 6A1-5 Exhaust Manifold

EXHAUST MANIFOLD (FIGURE 6A1-5)

Removal (Right Side)

1. Disconnect battery negative cable.
2. Remove plenum extension.
3. Disconnect EGR sensor wire.
4. Remove EGR pipe bolts at intake manifold.
5. Remove rear A/C compressor brace and let hang at compressor.
6. Disconnect dipstick tube at manifold and remove dipstick.
7. Remove AIR check valve at manifold.
8. Disconnect AIR hose at catalytic converter air pipe.
9. Disconnect wire at temperature sending unit.
10. Disconnect plug wires at plugs, head and at valve cover.
11. Remove spark plugs after engine has cooled.
12. Raise vehicle.
13. Remove catalytic converter AIR pipe clamp at manifold.
14. Disconnect exhaust crossover pipe at both manifolds.
15. Remove bolts from catalytic converter front hanger.
16. Remove catalytic converter AIR pipe.

17. Lower vehicle.
18. Remove exhaust manifold bolts.
19. Remove exhaust manifold and EGR pipe assembly.
20. Remove EGR pipe clamp and pipe if manifold is replaced.

Installation

1. Install EGR pipe with new clamp.
2. Clean gasket surfaces of manifold and head, then install manifold with new gaskets.
3. Raise vehicle and install AIR pipe with a new clamp.
4. Install bolts at converter hanger.
5. Reconnect crossover pipe at manifolds.
6. Install AIR pipe clamp at manifold.
7. Lower vehicle.
8. Install spark plugs and wires.
9. Connect wire at temperature sending unit and hose at catalytic converter AIR pipe.
10. Install AIR check valve.
11. Connect dipstick tube at manifold and install dipstick.
12. Install A/C compressor brace.
13. Install EGR pipe bolts at intake manifold and connect sensor wire.
14. Install plenum extension.
15. Connect battery.

Removal (Left Side)

1. Disconnect battery negative cable.
2. Remove air cleaner.
3. Disconnect PCV hose from intake and rocker cover.
4. Disconnect AIR hose at exhaust check valve.
5. Disconnect rear alternator brace at manifold and let hang at alternator.
6. Raise vehicle.
7. Disconnect exhaust pipe at manifold.
8. Lower vehicle.
9. Remove manifold bolts.
10. Remove manifold.

Installation

1. Clean mating surfaces on manifold and head, then install manifold in position and install bolts.
2. Raise vehicle.
3. Install exhaust pipe to manifold.
4. Connect alternator brace.
5. Connect AIR hose.
6. Connect PCV hose.
7. Install air cleaner.
8. Connect battery.

ROCKER ARM COVER

Removal (Right Side)

1. Remove RH exhaust manifold and EGR pipe assembly as previously outlined.
2. Remove fresh air pipe.
3. Loosen spark plug wire retainer at back of RH head and remove other wire retainers.

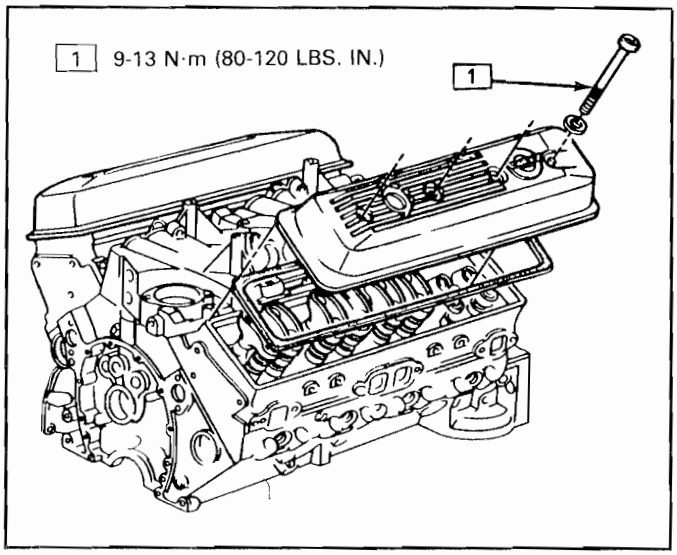


Figure 6A1-6 Rocker Arm Cover

4. Remove injector harness retaining nuts and move harness aside.
5. Disconnect heater control valve harness vacuum hose at intake.
6. Remove rocker cover bolts.
7. Remove rocker cover and gasket.

Removal (Left Side)

1. Disconnect battery negative cable.
2. Disconnect PCV valve at rocker cover.
3. Disconnect injector harness at intake.
4. Disconnect canister hose at pipe.
5. Disconnect brake booster vacuum hose at pipe.
6. Disconnect brake booster pipe at plenum.
7. Loosen AIR pump pulley bolts.
8. Disconnect serpentine belt at AIR pump.
9. Remove AIR pump pulley.
10. Loosen AIR pump lower mounting bolt.
11. Remove rocker cover bolts.
12. Remove rocker cover and gasket.

Installation (Both Sides)

1. Inspect cover for damage or distortion. If necessary, use a new cover to ensure a good sealing surface.
2. Install a new gasket.
3. Install cover and torque bolts (Figure 6A1-6).
4. Reverse removal procedures for remaining installation steps.

VALVE MECHANISM

Removal

1. Remove rocker arm covers as previously outlined.
2. Remove rocker arm nuts, rocker arm balls, rocker arms and push rods. Place rocker arms, rocker arm balls and push rods in a rack so they may be reinstalled in the same locations.

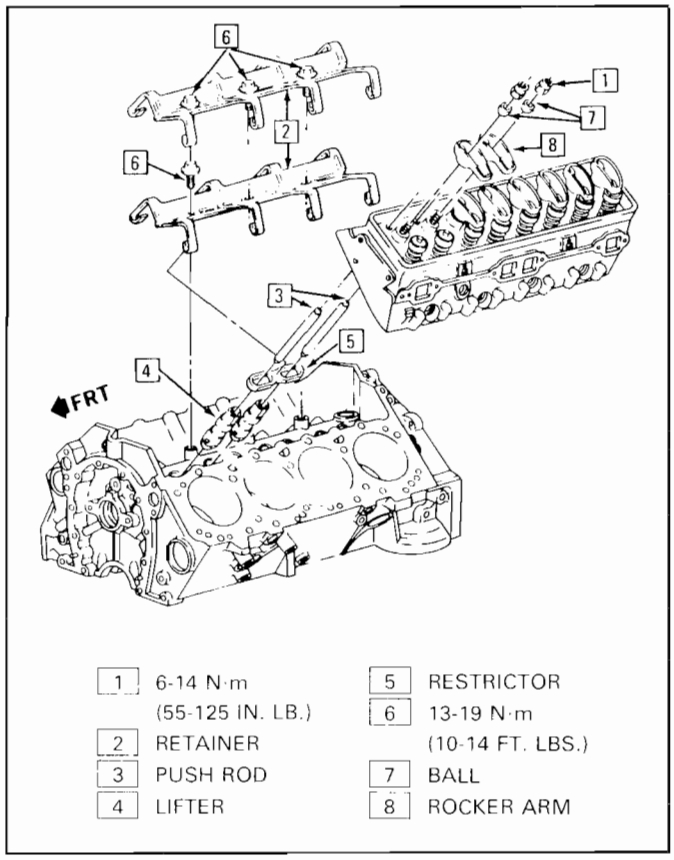


Figure 6A1-7 Rocker Arms and Pushrods

Installation and Adjustment

- Whenever new rocker arms and/or rocker arm balls are being installed, coat bearing surfaces of rocker arms and rocker arm balls with "Molykote" or its equivalent.

1. Install push rods. Be sure push rods seat in lifter socket.
2. Install rocker arms, rocker arm balls and rocker arm nuts. Tighten rocker arm nuts until there is no movement of the push rod. This can be determined by rotating pushrod while turning adjusting nut (Figure 6A1-8).
6. Adjust valves when lifter is on base circle of camshaft lobe as follows:
   a. Crank engine until mark on torsional damper lines up with center or "O" mark on the timing tab fastened to the crankcase front cover and the engine is in the #1 firing position. This may be determined by placing fingers on the #1 valve as the mark on the damper comes near the "O" mark on the crankcase front cover. If the valves are not moving, the engine is in the #1 firing position. If the valves move as the mark comes up to the timing tab, the engine is in #6 firing position and should be turned over one more time to reach the #1 position.
   b. With the engine in the #1 firing position as just determined, the following valves may be adjusted:
      - V8-Exhaust -- 1, 3, 4, 8

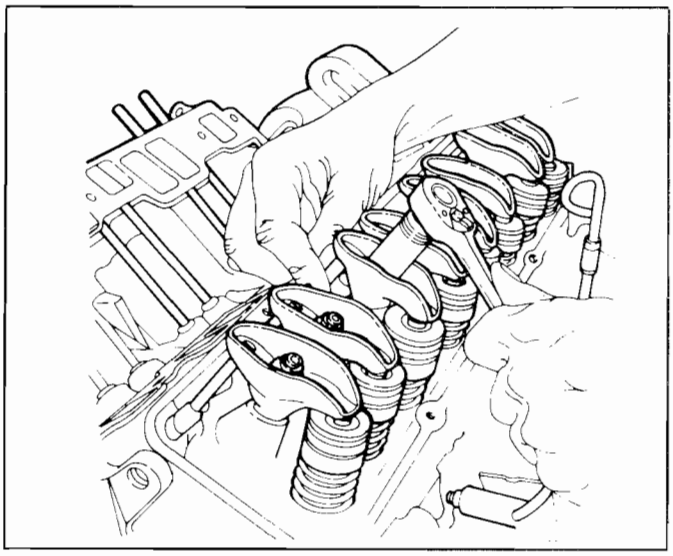


Figure 6A1-8 Valve Adjustment

      - V8-Intake -- 1, 2, 5, 7
   c. Turn adjusting nut one additional turn.
   d. Crank the engine one revolution until the pointer "0" mark and torsional damper mark are again in alignment. This is #6 firing position. With the engine in this position the following valves may be adjusted.
      - V8-Exhaust -- 2, 5, 6, 7
      - V8-Intake -- 3, 4, 6, 8
4. Install rocker arm covers as previously outlined.

VALVE STEM OIL SEAL AND/OR VALVE SPRING

Removal

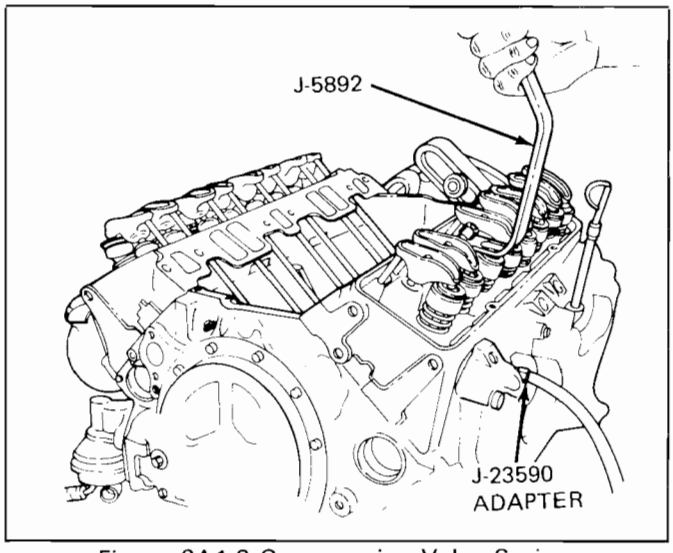


Figure 6A1-9 Compressing Valve Spring

1. Remove rocker arm cover as previously outlined.
2. Remove spark plug after engine has cooled, rocker arm and push rod on the cylinder(s) to be serviced.

3. Install air line adapter Tool J 23590 to spark plug port and apply compressed air to hold the valves in place.
4. Using Tool J 5892 to compress the valve spring, remove the valve locks, valve cap and valve spring and damper (Figure 6A1-9).
5. Remove the valve stem oil seals.

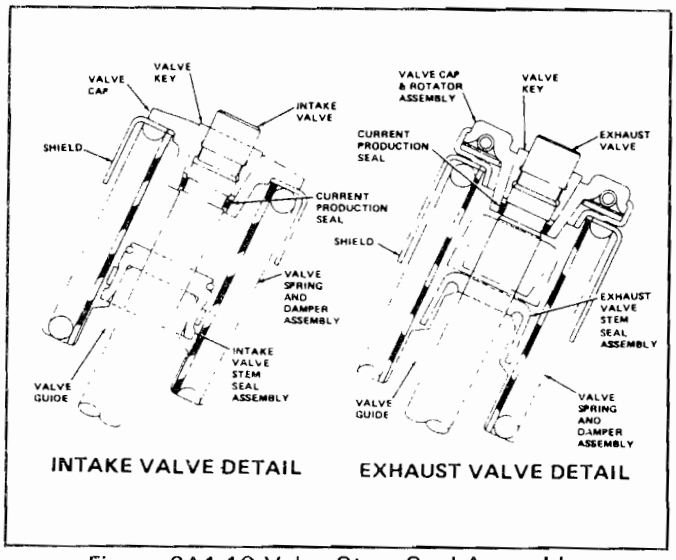


Figure 6A1-10 Valve Stem Seal Assembly

Installation

1. Install valve stem seal over valve stem and seat against head.
2. Set the valve spring and damper, oil shedder and valve cap (or rotator) in place. Compress the spring with Tool J 5892 and install oil seal in the lower groove of the stem, making sure the seal is flat and not twisted. A light coat of oil on the seal will help prevent twisting.
3. Install the valve stem keys (locks) and release the compressor tool making sure the keys seat properly in the upper groove of the valve stem. Grease may be used to hold the locks in place while releasing the compressor tool.
4. Using tool J 23994, apply vacuum to the valve cap to make sure no air leaks past the seal.
5. Install spark plug and torque to 22 lb. ft. (30 N·m).
6. Install and adjust valve mechanism as previously outlined.

VALVE LIFTERS

Hydraulic valve lifters very seldom require attention. The lifters are extremely simple in design, readjustments are not necessary, and servicing of the lifters requires only that care and cleanliness be exercised in the handling of parts.

Valve Lifter Diagnosis

1. Momentarily Noisy When Car is Started:
   This condition is normal. Oil drains from the lifters which are holding the valves open when the engine is not running. It will take a few seconds for the lifter to fill after the engine is started.

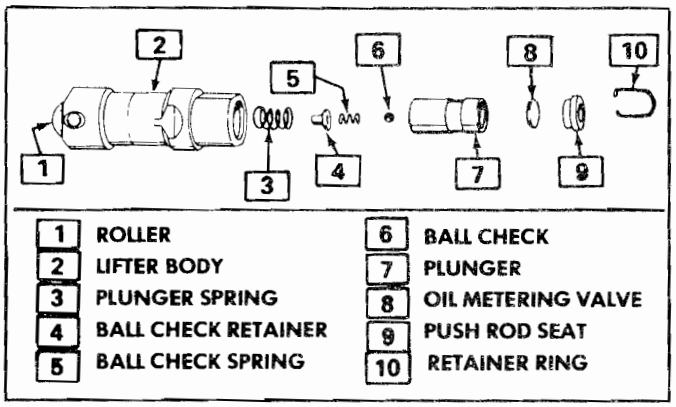


Figure 6A1-11 Hydraulic Roller Valve Lifter

2. Intermittently Noisy On Idle Only. Disappearing When Engine Speed is Increased:
   Intermittent clicking may be an indication of a pitted check valve ball, or it may be caused by dirt.
   Correction: Clean the lifter and inspect. If check valve ball is defective, replace lifter.
3. Noisy At Slow Idle Or With Hot Oil, Quiet With Cold Oil Or As Engine Speed Is Increased:
   High leak down rate. Replace suspect lifter.
4. Noisy At High Car Speeds And Quiet At Low Speeds:
   a. High oil level - Oil level above the "Full" mark allows crankshaft counterweights to churn the oil into foam. When foam is pumped into the lifters, they will become noisy since a solid column of oil is required for proper operation. Correction: Drain oil intil proper level is obtained.
   b. Low oil level - Oil level below the "Add" mark allows the pump to pump air at high speeds which results in noisy lifters. Correction: Fill until proper oil level is obtained.
   c. Oil pan bent on bottom or pump screen cocked or loose, replace or repair as necessary.
5. Noisy At Idle Becoming Louder As Engine Speed Is Increased To 1500 rpm:
   This noise is not connected with lifter malfunction. It becomes most noticeable in the car at 10 to 15 mph "1" (Low) range, or 30 to 35 mph "D" (Drive) range and is best described as a hashy sound. At slow idle, it may be entirely gone or appear as a light ticking noise in one or more valves. It is caused by one or more of the following:
   a. Badly worn or scuffed valve tip and rocker arm pad.
   b. Excessive valve stem to guide clearance.
   c. Excessive valve seat runout.
   d. Off square valve spring.
   e. Excessive valve face runout.
   f. Valve spring damper clicking on rotator.

Removal

1. Remove intake manifold as previously outlined.

2. Remove valve mechanism as previously outlined.
3. Remove valve lifters. Place valve lifters in a rack so that they may be reinstalled in the same location.

Installation

1. Coat roller of valve lifters with "Molykote" or its equivalent and install valve lifters.
2. Install intake manifold as previously outlined.
3. Install and adjust valve mechanism as previously outlined.

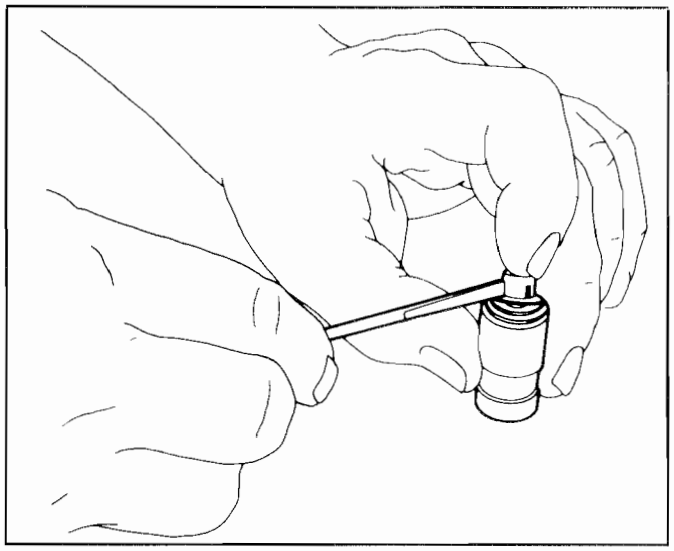


Figure 6A1-12 Removing Ball Check Valve-Typical

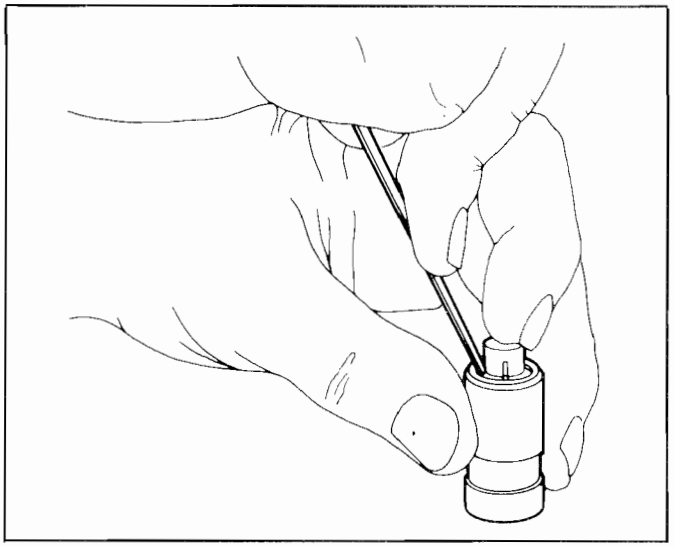


Figure 6A1-13 Installing Ball Check Valve-Typical

Disassembly

1. Hold the plunger down with a push rod, and using the blade of a small screwdriver, remove the push rod seat retainer.
2. Remove the push rod seat and metering valve.
3. Remove the plunger, ball check valve assembly and the plunger spring.
4. Remove the ball check valve and spring by prying the ball retainer loose from the plunger with the blade of a small screwdriver.

Cleaning and Inspection

Thoroughly clean all parts in cleaning solvent, and inspect them carefully. If any parts are damaged or worn, the entire lifter assembly should be replaced.

1. Lifter body for:
   - Wear
   - Scuffing. Also inspect the bore in the cylinder block.
   - Flat spot on the bottom. If the bottom is worn flat or grooved, replace the lifter. Also inspect the camshaft lobe.
2. Roller for:
   - Freedom of movement. Replace the lifter if it binds or roughness can be felt.
   - Excessive looseness in the roller bearings. Replace lifter if necessary.
   - Flat spots. Replace the lifter, if worn.
   - Pitting, replace the lifter if pitted.
3. Pushrod seat. If worn, inspect the pushrod. Replace the pushrod, if worn.

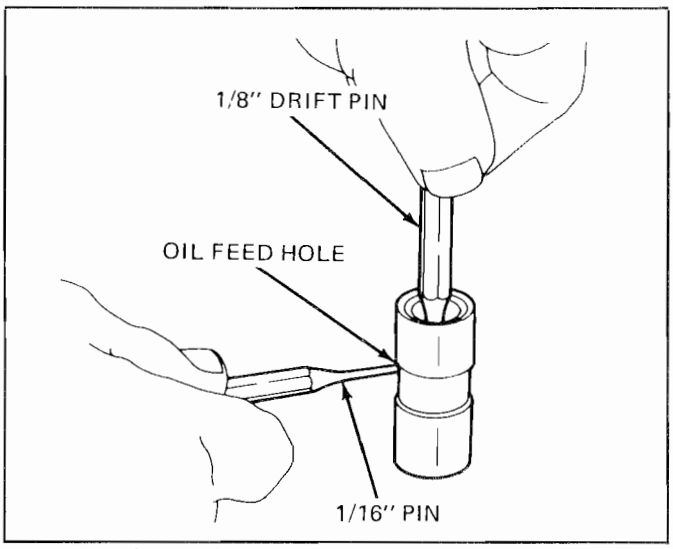


Figure 6A1-14 Assemblying Hydraulic Lifter-Typical

Assembly

1. Place the check ball on small hole in bottom of the plunger.
2. Insert check ball spring on seat in ball retainer and place retainer over ball so that spring rests on the ball. Carefully press the retainer into position in plunger with the blade of a small screw driver.
3. Place the plunger spring over the ball retainer and slide the lifter body over the spring and plunger, being careful to line up the oil feed holes in the lifter body and plunger.
4. Fill the assembly with SAE 10 oil, then insert the end of a 1/8" drift pin into the plunger and press down solid - do not attempt to force or pump the plunger. At this point, oil holes in the lifter body and plunger assembly will be aligned.
5. Insert a 1/16" drift pin through both oil holes to hold the plunger down against the lifter spring tension.
6. Remove the 1/8" drift pin, refill assembly with SAE 10 oil.

7. Install the metering valve and push rod seat.
8. Install the push rod seat retainer, press down on the push rod seat and remove the 1/16" drift pin from the oil holes. The lifter is now completely assembled, filled with oil and ready for installation. Before installing lifters, coat the bottom of the lifter with "Molykote" or its equivalent.

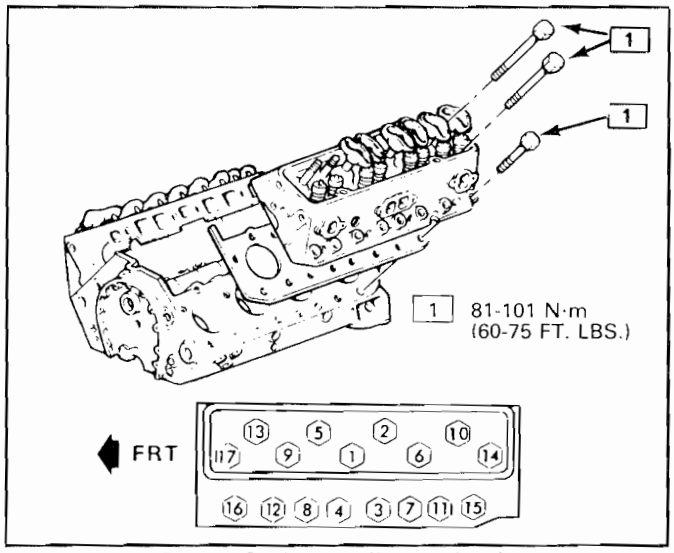


Figure 6A1-15 Cylinder Head

CYLINDER HEAD ASSEMBLY (FIGURE 6A1-15)

1. Remove intake as previously outlined.
2. Disconnect rear A/C brace at exhaust manifold.
3. Disconnect dipstick tube at manifold and remove dipstick.
4. Remove check vavle from AIR manifold.
5. Disconnect AIR hose at catalytic converter AIR pipe.
6. Disconnect wire at temperature sending unit.
7. Disconnect plug wires at plugs, head and rocker cover.
8. Remove spark plugs after engine has cooled.
9. Raise vehicle.
10. Disconnect converter AIR pipe clamp at manifold.
11. Disconnect exhaust pipe at both manifolds.
12. Remove front converter hanger bolts.
13. Remove converter AIR pipe.
14. Lower vehicle.
15. Remove exhaust manifold bolts.
16. Remove exhaust manifold with EGR pipe.
17. Remove spark plug wire retainers.
18. Remove rocker cover.
19. Disconnect serpentine belt at A/C compressor.
20. Disconnect wires at A/C compressor.
21. Loosen (2) rear A/C mount bolts.
22. Remove A/C bracket nuts from water pump studs.
23. Loosen front A/C mount bolt and slide A/C compressor and bracket forward.
24. Remove push rods.
25. Remove head bolts and remove head.

Removal (Left Side)

1. Remove intake.
2. Disconnect AIR hose at check valve.
3. Remove alternator brace.
4. Disconnect wire at fan temperature sensor.
5. Raise vehicle.
6. Disconnect exhaust pipe at manifold.
7. Lower vehicle.
8. Remove exhaust manifold bolts.
9. Remove L/H exhaust manifold.
10. Disconnect serpentine belt at AIR pump.
11. Remove AIR pump with bracket.
12. Remove rocker cover.
13. Remove spark plugs after engine has cooled.
14. Disconnect P/S, alternator mount bracket at head.
15. Remove push rods.
16. Remove head bolts and head.

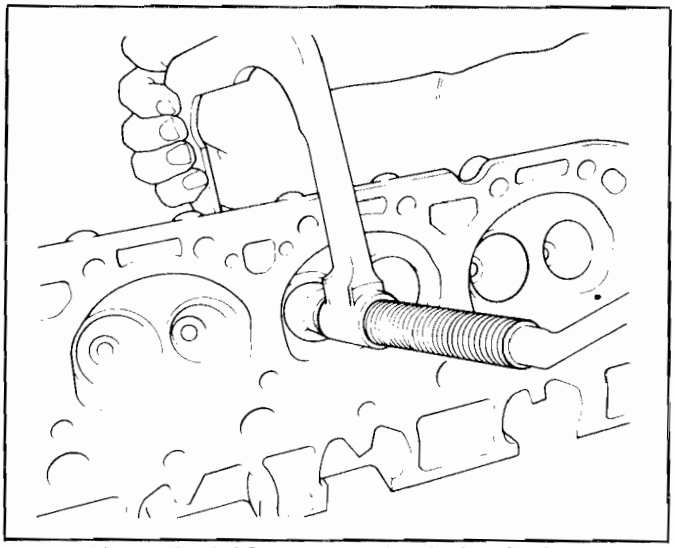


Figure 6A1-16 Compressing Valve Spring

Disassembly

1. With cylinder head removed, remove valve rocker arm nuts, balls and rocker arms (if not previously done).
2. Using Tool J 8062, compress the valve springs (Figure 6A1-16) and remove stem keys. Release the compressor tool and remove rotators or spring caps, oil shedders, springs and damper assembly, then remove oil seals, valve spring seats and valve spring shims.
3. Remove valves from cylinder head and place them in a rack in their proper sequence so that they can be assembled in their original positions.

Cleaning

1. Clean all carbon from combustion chambers and valve ports using Tool J 8089 (Figure 6A1-17).
2. Thoroughly clean the valve guides using Tool J 8101 (Figure 6A1-18).
3. Clean all carbon and sludge from push rods, rocker arms and push rod guides.

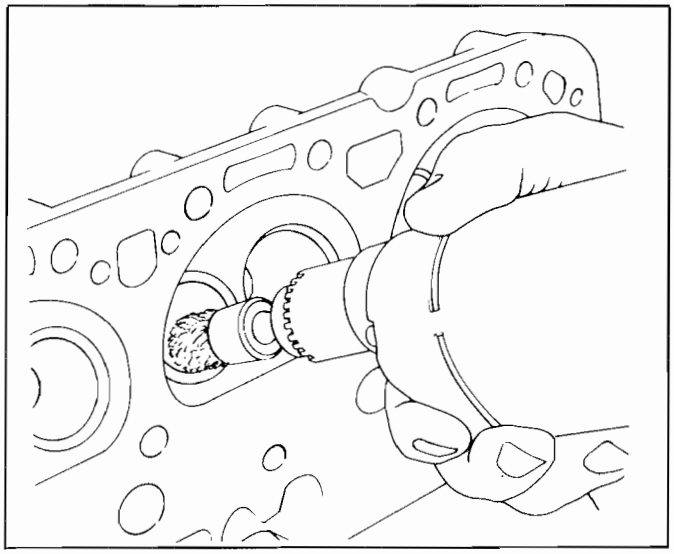


Figure 6A1-17 Cleaning Combustion Chambers

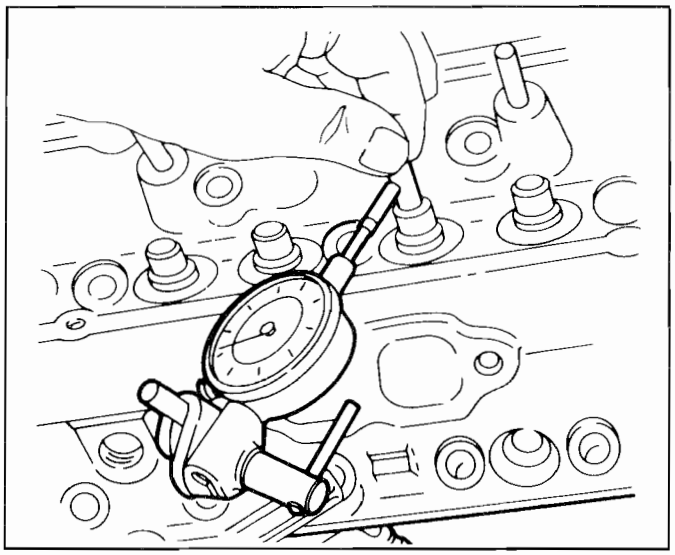


Figure 6A1-19 Measuring Valve Stem Clearances

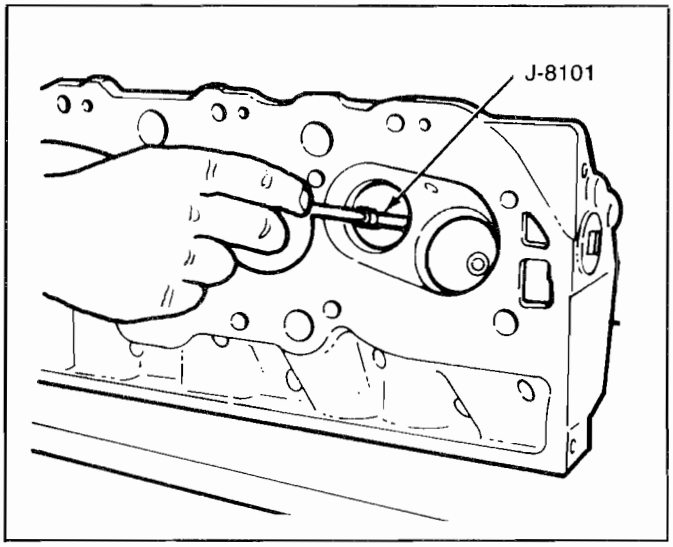


Figure 6A1-18 Cleaning Valve Guides

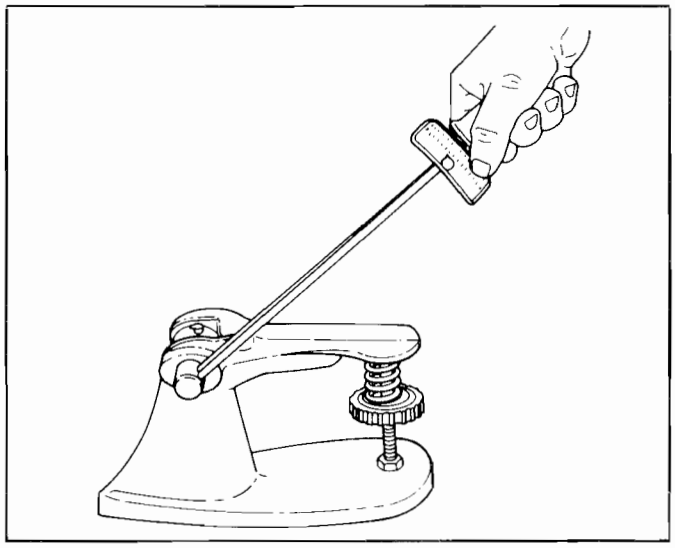


Figure 6A1-20 Checking Valve Spring Tension

4. Clean valve stems and heads on a buffing wheel.
5. Clean carbon deposits from head gasket mating surface using 400 grid wet sandpaper or fine steel wool with mineral spirits.

Inspection

1. Inspect the cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks to the water chamber.
2. Inspect the valves for burned heads, cracked faces or damaged stems.
   - Excessive valve stem to bore clearance will cause excessive oil consumption and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine smoothenss.
3. Measure valve stem clearance (Figure 6A1-19) as follows:
   a. Clamp a dial indicator on one side of the cylinder head rocker arm cover gasket rail.
   b. Locate the indicator so that movement of the valve stem from side to side (crosswise to the head) will cause a direct movement of the indicator stem. The indicator stem must contact the side of the valve stem just above the valve guide.
   c. Drop the valve head about 1/16″ off the valve seat.
   d. Move the stem of the valve from side to side using light pressure to obtain a clearance reading. If clearance exceeds specifications, it will be necessary to ream valve guides for oversize valves.
      - Service valves are available in standard, .003″, .015″ and .030″ oversize.
4. Check valve spring tension with Tool J 8056 spring tester (Figure 6A1-20). Springs should be compressed to the specified height and checked against the specifications chart. Springs should be replaced if not within 10 lbs. (44 N) of the specified load (without dampers).
5. Inspect rocker arm studs for wear of damage. Check rocker arm stud torque (50 lb. ft.).

Assembly

1. Insert a valve in the proper port.
2. Assemble the valve spring and related parts as follows:
   a. Set the valve spring seat and shim, valve spring, damper assembly, oil shedder and valve cap or rotator in place.
   b. Compress the spring with Tool J 8062.
   c. Install oil seal in the lower groove of the stem, making sure that the seal is flat and not twisted.
   d. Install the valve and release the compressor tool making sure that the valve stems seat properly in the upper groove of the valve stem. Grease may be used to hold the locks in place while releasing the compressor tool.
3. Install the remaining valves.
4. Check each valve stem oil seal by placing Valve Seal Leak Detector (Tool J 23994) over the end of the valve stem and against the cap (or rotator). Operate the vacuum pump and make sure no air leaks past the seal (Figure 6A1-20).

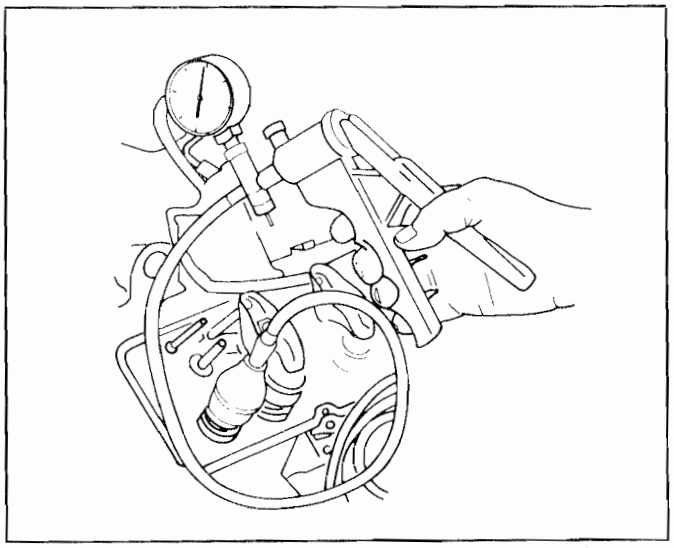


Figure 6A1-21 Checking Valve Stem Oil Seals

5. Check the installed height of the valve springs, using a narrow thin scale. A cutaway scale will help. Measure from the top of the shim or the spring seat to the top of the oil shedder (Figure 6A1-22). If this is found to exceed the specified height, install a valve spring seat shim approximately 1/16" (1.6mm) thick under the spring seat. At no time should the spring be shimmed to give an installed height under the minimum specified.

Installation

- The gasket surfaces on both the head and the block must be clean of any foreign matter and free of nicks or heavy scratches. Cylinder bolt threads in the block and threads on the cylinder head bolts must be clean, as dirt will affect bolt torque.

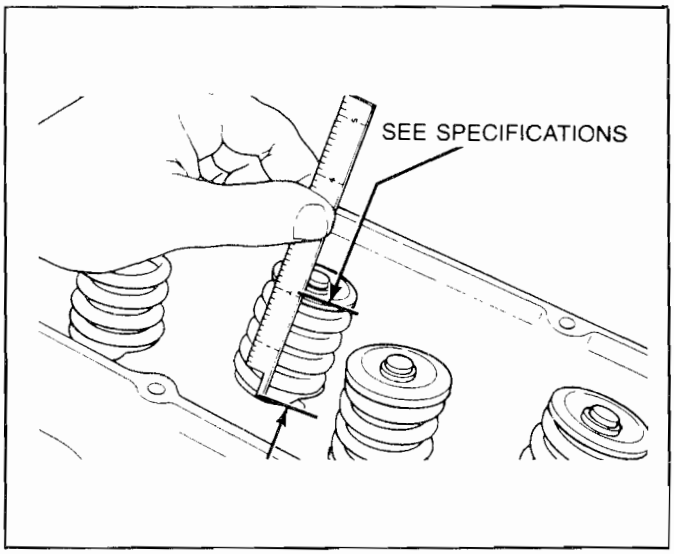


Figure 6A1-22 Measuring Valve Spring Installation Height

1. Use a composition material head gasket ONLY; do not use a steel gasket. Install the gasket dry, without a gasket sealer.
2. Place the gasket in position over the dowel pins with the bead up.
3. Carefully guide the cylinder head into place over the dowel pins and gasket.
4. Coat threads of cylinder head bolts with sealing compound, #1052080 or equivalent, and install bolts finger tight.
5. Tighten each cylinder head bolt a little at a time until the specified torque is reached (Figure 6A1-15).
6. Install exhaust manifolds as previously outlined.
7. Install intake manifold as previously outlined.
8. Install and adjust valve mechanism as previously outlined.

ROCKER ARM STUDS

Rocker arm studs that have damaged threads should be replaced with new studs. Coat threads of rocker arm stud with sealing compound #1052080 or equivalent.

Replacement

1. Install new rocker arm stud and torque to 68 N·m (50 lb. ft.).

VALVE GUIDE BORES

Valves with oversize stems are available (see specifications). To ream the valve guide bores for oversize valves use Tool Set J 5830.

VALVE SEATS

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the engine to deliver the power and performance built into it.

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat in the head is imperative to insure that the heat in the valve head will be properly carried away.

Several different types of equipment are available for reseating valves seats. The manufacturer's recommendations for the equipment being used should be carefully followed to attain proper results.

VALVES

Valves that are pitted can be refaced to the proper angle, insuring correct relation between the head and stem on a valve refacing machine. Valve stems which show excessive wear, or valves that are warped excessively should be replaced. When a valve head which is warped excessively is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than 1/32" (.08mm) thick after grinding, replace the valve.

Several different types of equipment are available for refacing valves. The manufacturer's recommendations for the equipment being used should be carefully followed to attain proper results.

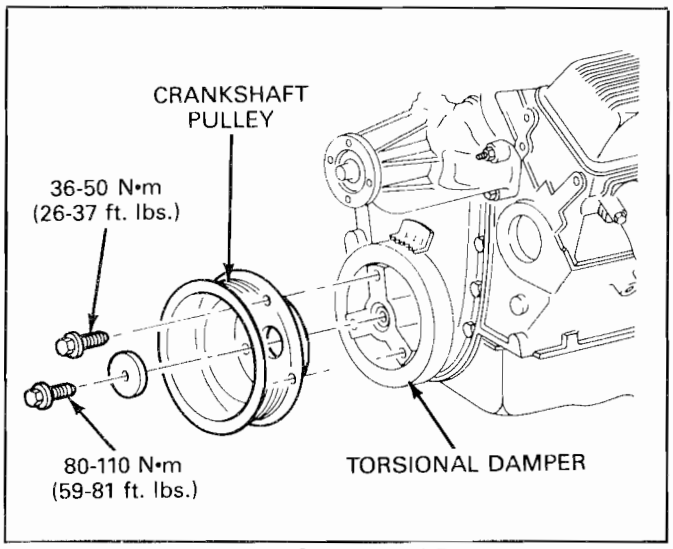


Figure 6A1-23 Torsional Damper

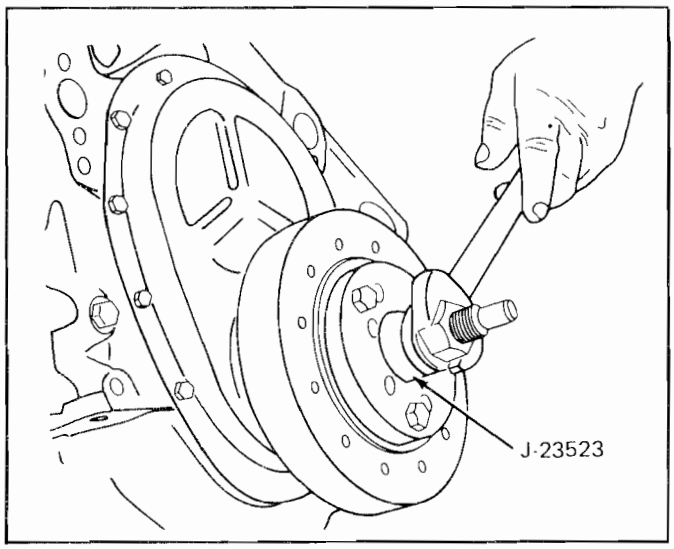


Figure 6A1-24 Installing Torsional Damper

TORSIONAL DAMPER (FIGURE 6A1-23)

Removal

1. Disconnect battery negative cable.
2. Remove drive belt.
3. Remove crankshaft pulley.
4. Install tool J 23523 on damper. Turn puller screw and remove damper.

   NOTICE: The use of any other type puller, such as a universal claw, which pulls on the outside of the hub can destroy the torsional damper. The outside ring is bonded in rubber to the hub. It is possible to break the bond.

5. It may be necessary to remove power steering line in order to install balancer puller.

Installation

1. Inspect front cover seal for damage or grooving. Coat seal contact area (on damper) with engine oil.
2. Place damper in position over key on crankshaft.
3. Pull damper onto crankshaft as follows:
   a. Install appropriate threaded end of Tool J 23523 into crankshaft. Install tool in crankshaft so that at least 1/2" (13mm) of thread engagement is obtained.
   b. Install plate, thrust bearing and nut to complete tool installation.
   c. Pull damper into position.
   d. Remove tool from crankshaft then install damper retaining bolt and torque to specifications.
4. Install crankshaft pulley.
5. Install drive belt.

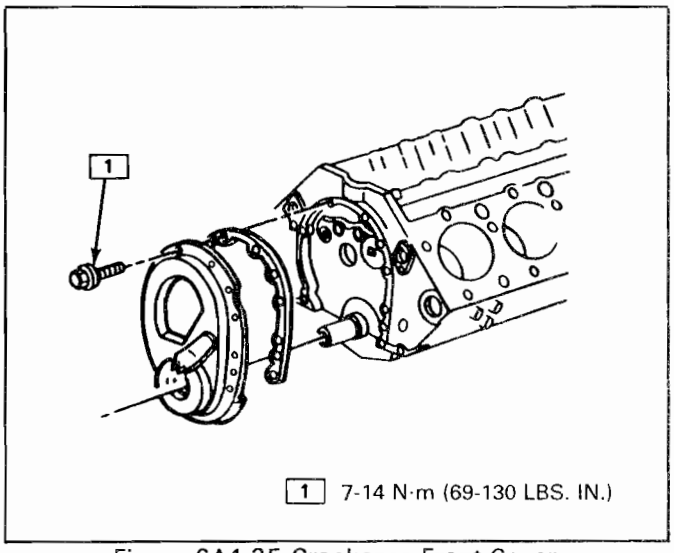


Figure 6A1-25 Crankcase Front Cover

CRANKCASE FRONT COVER (FIGURE 6A1-25)

Removal

1. Remove torsional damper as previously outlined.
2. Remove oil pan.
3. Remove AIR pump pulley.

4. Remove air management valve adapter.
5. Remove AIR pump bolts.
6. Remove AIR pump.
7. Disconnect fuel inlet and return pipes.
8. Remove rear A/C compressor braces.
9. Remove lower A/C compressor mounting bolt.
10. Remove compressor bracket nuts at water pump.
11. Slide mounting bracket forward and remove compressor mounting bolt.
12. Disconnect wires at compressor and lay compressor aside.
13. Disconnect AIR hose at right exhaust manifold.
14. Remove compressor mounting bracket.
15. Remove upper AIR pump bracket with power steering reservoir.
16. Remove lower AIR pump bracket.
17. Drain cooling system.
18. Disconnect radiator and heater hoses at water pump.
19. Remove water pump.
20. Remove front cover bolts.
21. Remove front cover.

Installation

1. Clean gasket surface on block and crankcase front cover.
2. Use a sharp knife or other suitable cutting tool to remove any excess oil pan gasket material that may be protruding at the oil pan to engine block junction.
3. Inspect the crankcase front cover for damage or distortion and replace if necessary.
4. Coat the cover gasket with gasket sealant and place in position on cover.
5. Install cover.
6. Tighten screws alternately and evenly. Position cover so that dowels enter holes in cover without binding. Do not force cover over dowels so that cover flange or holes are distorted.
7. Install remaining cover screws and torque to specifications.
8. Apply 1052080 sealant or equivalent onto the two front corners where the cover meets the case and where the rear seal retainer meets the case before installing oil pan gasket (Figure 6A1-32).
9. Install oil pan and gasket.
10. Install torsional damper and water pump as previously outlined.
11. Reverse remaining removal procedures for installation.

OIL SEAL (FRONT COVER)

Replacement

With Cover Removed

1. With cover removed, pry oil seal out of cover from the front with a large screwdriver, being careful not to damage cover.
2. Install new seal so that open end of the seal is toward the inside of cover and drive it into position with Tool J 35468. Support rear of cover at seal area.

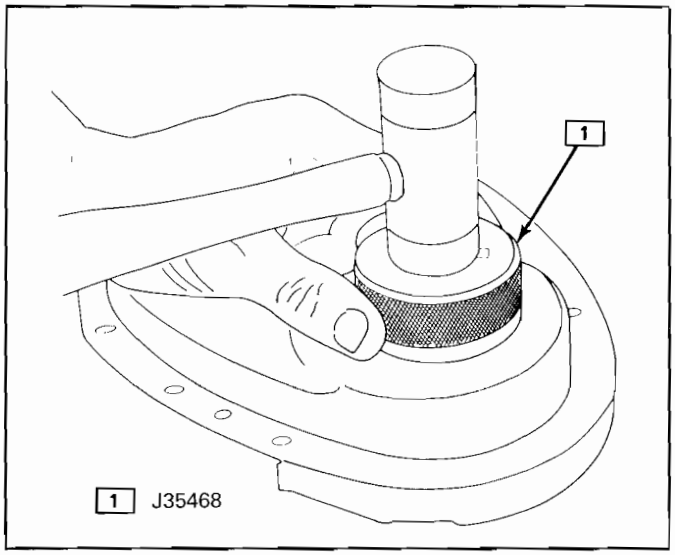


Figure 6A1-26 Installing Oil Seal-Cover Removed

With Cover Installed

1. With torsional damper removed, pry seal out of cover from the front with a large screwdriver. Be careful not to damage the surface on the cover or the surface of the crankshaft.
2. Install new seal so that open end of seal is toward the inside of cover and drive it into position with Tool J 35468.

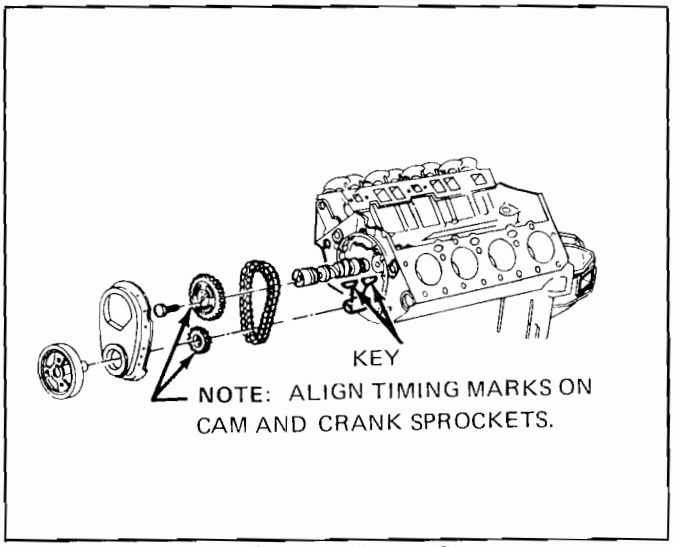


Figure 6A1-27 Timing Chain

TIMING CHAIN

Removal

1. Remove front cover as previously outlined.
2. Rotate crankshaft and align timing marks.
3. Remove cam gear bolts.
4. Remove chain and gear.
5. For installation, reverse removal procedures.

CAMSHAFT

Measuring Lobe Lift

1. Remove the valve mechanism as previously outlined.

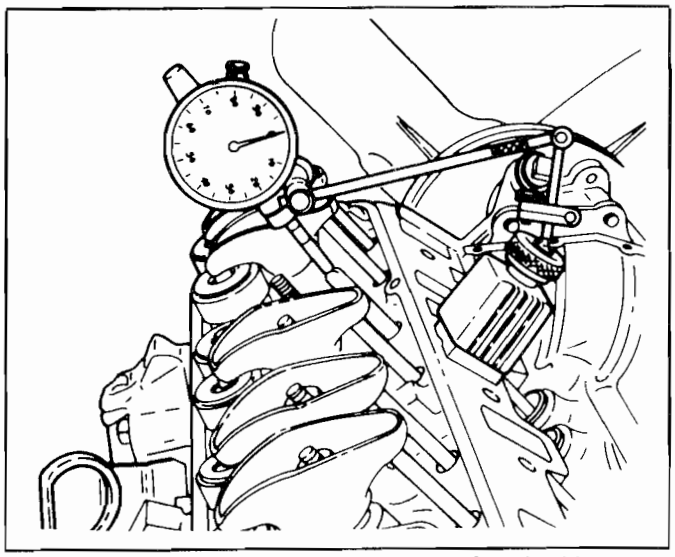


Figure 6A1-28 Measuring Camshaft Lobe Lift

2. Position indicator with ball socket adapter (Tool J 8520) on push rod (Figure 6A1-28). Make sure push rod is in the lifter socket.
3. Rotate the crankshaft slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the push rod will be in its lowest position.
4. Set dial indicator on zero, then rotate the crankshaft slowly, or attach an auxiliary starter switch and "bump" the engine over, until the push rod is fully raised position.
   - Whenever the engine is cranked remotely at the started, with a special jumper cable or other means, the distributor primary lead should be disconnected from the distributor.
5. Compare the total lift recorded from the dial indicator with specifications.
6. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
7. Install and adjust valve mechanism as outlined.

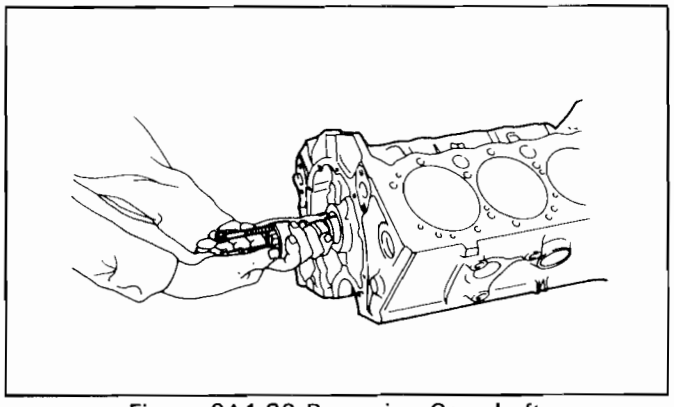


Figure 6A1-29 Removing Camshaft

Removal

1. Remove intake manifold as previously outlined.
2. Remove crank pulley.
3. Remove harmonic balancer.
4. Remove power steering line, in order to gain access to torsional damper for installation.
5. Remove rear A/C compressor braces.
6. Remove lower A/C compressor mounting bolt.
7. Remove A/C compressor bracket nuts at water pump..
8. Slide mounting bracket forward and remove compressor upper mounting bolt.
9. Disconnect wires at compressor and lay A/C compressor aside.
10. Disconnect AIR hoses at right exhaust manifold.
11. Remove compressor mounting bracket.
12. Remove upper AIR pump bracket with power steering reservoir.
13. Remove AIR pump lower bracket.
14. Disconnect radiator hoses at water pump.
16. Remove front cover bolts.
17. Remove front cover.
18. Rotate crankshaft and align timing marks.
19. Remove cam gear bolts.
20. Remove chain and gear.
21. Remove alternator bolts and lay aside.
22. Disconnect left spark plug wires at spark plugs, remove rocker cover bolts.
23. Bend bracket at rear of head and remove rocker cover.
24. Remove right exhaust manifold.
25. Remove right rocker cover bolts.
26. Bend bracket at rear of head and remove rocker cover.
27. Remove all push rods.
28. Remove lifters.
29. Remove upper and lower radiator hoses.
30. Disconnect A/C accumulator from shroud and lay aside.
31. Disconnect upper transmission cooler line at radiator.
32. Disconnect fan wire at fan and fan shroud.
33. Remove cooling fan.
34. Disconnect lower transmission cooler line and remove fitting at radiator.
35. Remove upper fan shroud bolts and remove shroud.
36. Remove radiator.
37. Disconnect A/C high pressure line bracket at right frame rail.
38. Swing A/C condensor up and rest on top of lower shroud.
39. Remove camshaft.

Inspection

The camshaft bearing journals should be measured with a micrometer for an out-of-round condition. If the journals exceed .001" out-of-round, the camshaft should be replaced.

Installation

When a new camshaft is installed coat camshaft lobes with "Molykote" or its equivalent.

When a new camshaft is installed, install new oil, new filter and replacement of all valve lifters is

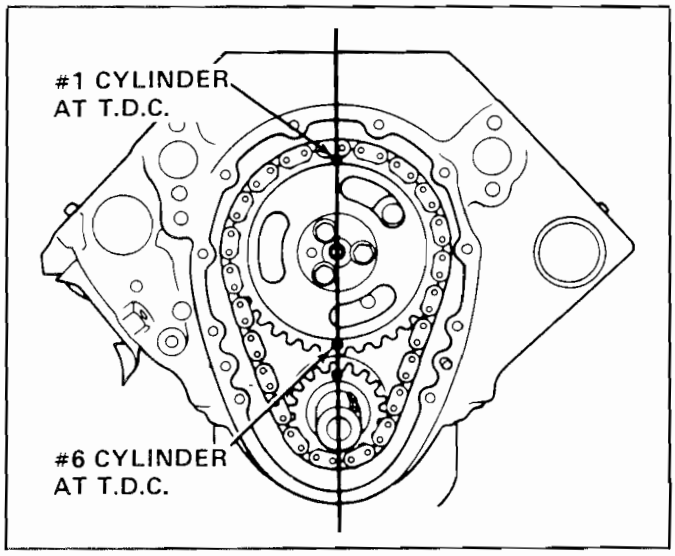


Figure 6A1-30 Aligning Timing marks

recommended to insure durability of the camshaft lobes and lifter feet.

1. Lubricate camshaft journals with engine oil and install camshaft.
2. Install timing chain on camshaft sprocket. Hold the sprocket vertically with the chain hanging down and align marks on camshaft and crankshaft sprockets. (Refer to Figure 6A1-30).
3. Align dowel in camshaft with dowel hole in camshaft sprocket then install sprocket on camshaft.
4. Draw the camshaft sprocket onto camshaft using the mounting bolts. Torque to specifications.
5. Lubricate timing chain with engine oil.
6. Install crankcase front cover as previously outlined.
7. Install valve lifters as previously outlined.
8. Reverse remaining removal procedures for installation.

CAMSHAFT BEARINGS

Removal

Camshaft bearings can be replaced with engine completely or partially disassembled. To replace bearings without complete disassembly remove the camshaft and crankshaft leaving cylinder heads attached and pistons in place. Before removing crankshaft, tape threads of connecting rod bolts to prevent damage to crankshaft. Fasten connecting rods against sides of engine so they will not be in the way while replacing camshaft bearings.

1. With camshaft and crankshaft removed, drive camshaft rear plug from cylinder block.
2. Using Tool J 6098, with nut and thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.
3. Install remover and installer tool with shoulder toward bearing, making sure a sufficient amount of threads are engaged.
4. Using two wrenches, hold puller screw while turning nut. When bearing has been pulled from bore, remove remover and installer tool and bearing from puller screw.
5. Remove remaining bearings (except front and rear) in the same manner. It will be necessary to index pilot in camshaft rear bearing to remove the rear intermediate bearing.
6. Assemble remover and installer tool on driver handle and remove camshaft front and rear bearings by driving towards center of cylinder block.

Installation

The camshaft front and rear bearings should be installed first. These bearings will act as guides for the pilot and center the remaining bearings being pulled into place.

1. Assemble remover and installer tool on driver handle and install camshaft front and rear bearings by driving towards center of cylinder block.
2. Using Tool Set J-6098, with nut then thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.
3. Index camshaft bearing in bore (with oil hole aligned as outlined below), then install remover and installer tool on puller screw with shoulder toward bearing.
   - Number one cam bearing oil hole must be positioned so that oil holes are at the 1 o'clock and 5 o'clock position.
   - Number two through number four bearing oil holes must be positioned at 5 o'clock position (toward left side of engine and at a position even with bottom of cylinder bore).
   - Number five bearing oil hole must be in 12 o'clock position.
4. Using two wrenches, hold puller screw while turning nut. After bearing has been pulled into bore, remove the remover and installer tool from puller screw and check alignment of oil hole in camshaft bearing.
5. Install remaining bearings in the same manner. It will be necessary to index pilot in the camshaft rear bearing to install the rear intermediate bearing.
6. Coat new camshaft rear plug O.D. with #1052080 sealant, or equivalent, and install flush to 1/32" (.80mm) deep.

OIL PAN (FIGURE 6A1-31)

Removal

1. Disconnect battery negative cable.
2. Raise vehicle.
3. Drain crankcase.
4. Disconnect transmission oil cooler lines at flywheel cover.
5. Disconnect catalytic converter AIR pipe clamps at manifold and exhaust pipe.
6. Disconnect wires at starter.
7. Disconnect brace at starter.
8. Remove starter.

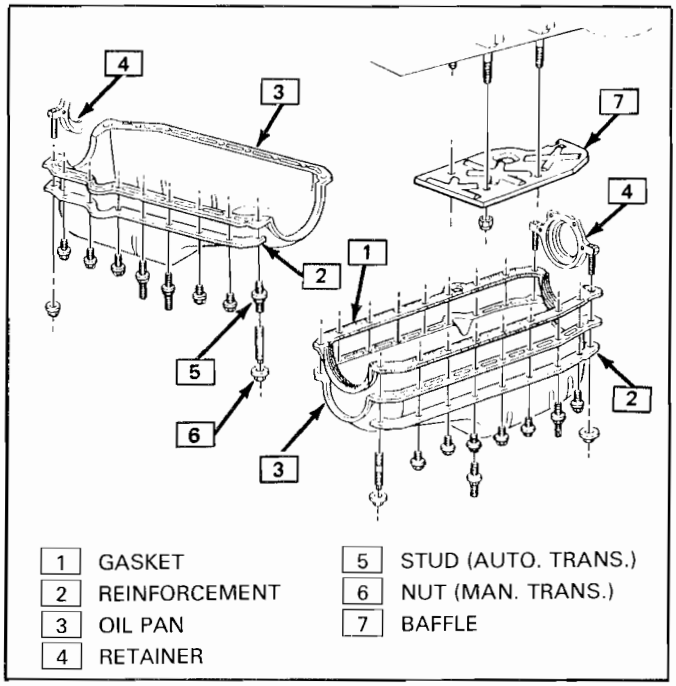


Figure 6A1-31 Oil Pan

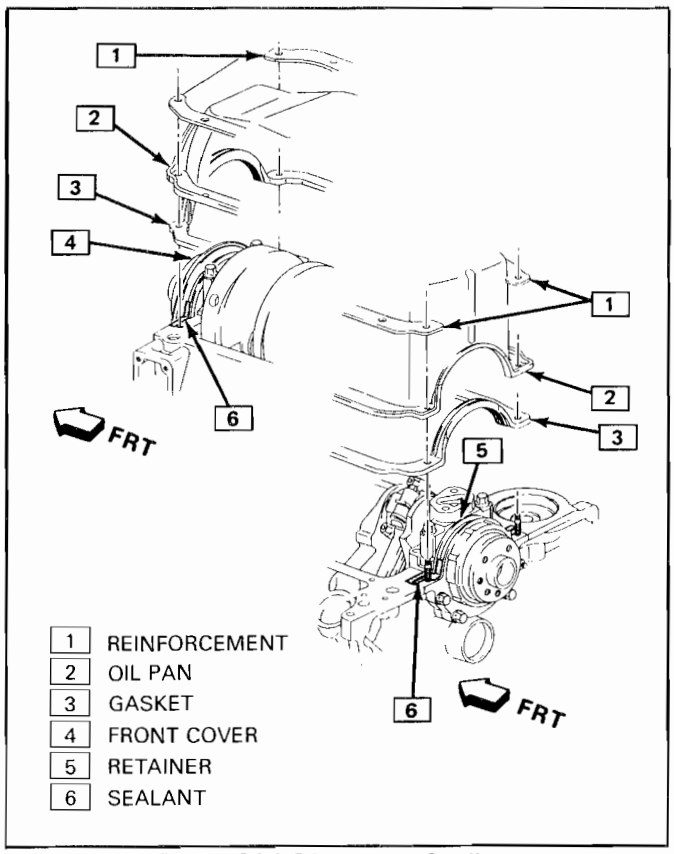


Figure 6A1-32 Oil Pan Sealing

9. Remove oil filter.
10. Disconnect oil cooler adapter at block.
11. Remove flywheel cover.
12. Disconnect oil cooler line at oil pan.
13. Remove ESC sensor shield.
14. Remove front crossmember braces.
15. Remove oil pan bolts.
16. Rotate crankshaft.
17. Remove oil pan.

Installation

1. Clean sealing surfaces on cylinder case and oil pan.
2. Apply 1052080 sealant or equivalent onto the two front corners where the cover meets the case and where the rear seal retainer meets the case before installing the oil pan gasket (Figure 6A1-32).
3. Check oil pan gasket for damage and replace if necessary.
4. Install oil pan and gasket and torque bolts to specifications.
5. Reverse remainder of removal procedures.
6. Connect battery and check for leaks.

OIL PUMP

Removal

1. Remove oil pan as previously outlined.
2. Remove pump to rear main bearing cap bolt and remove pump and extension shaft.

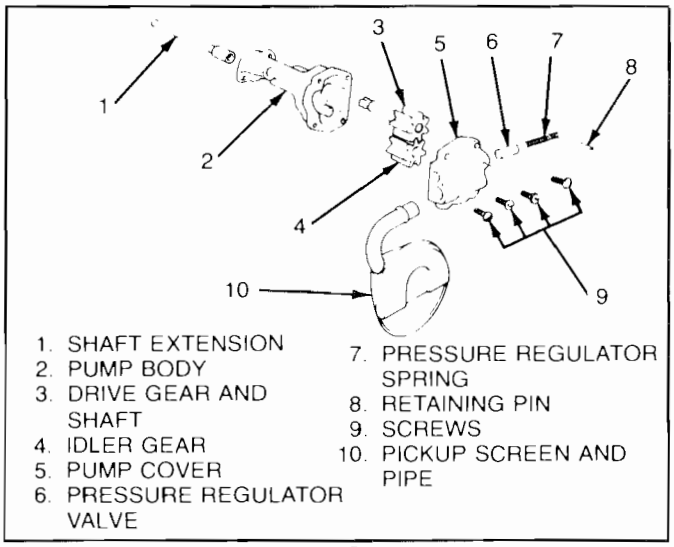


Figure 6A1-33 Oil Pump

Disassembly (Figure 6A1-33)

1. Remove the pump cover attaching screws and the pump cover.
2. Mark gear teeth so they may be reassembled with the same teeth indexing. Remove the idler gear and the drive gear and shaft from the pump body.
3. Remove the pressure regulator valve retaining pin, pressure regulator valve and related parts.
4. If the pickup screen and pipe assembly need replacing, mount the pump in a soft-jawed vise and extract pipe from pump. Do not disturb the pickup screen on the pipe. This is serviced as an assembly.

Cleaning and Inspection

1. Wash all parts in cleaning solvent and dry with compressed air.
2. Inspect the pump body and cover for cracks or excessive wear.

3. Inspect pump gears for damage or excessive wear.
   - The pump gears and body are not serviced separately. If the pump gears or body are damaged or worn, replacement of the entire oil pump assembly is necessary.
4. Check the drive gear shaft for looseness in the pump body.
5. Inspect inside of pump cover for wear that would permit oil to leak past the ends of the gears.
6. Inspect the pickup screen and pipe assembly for damage to screen, pipe or relief grommet.
7. Check the pressure regulator valve for fit.

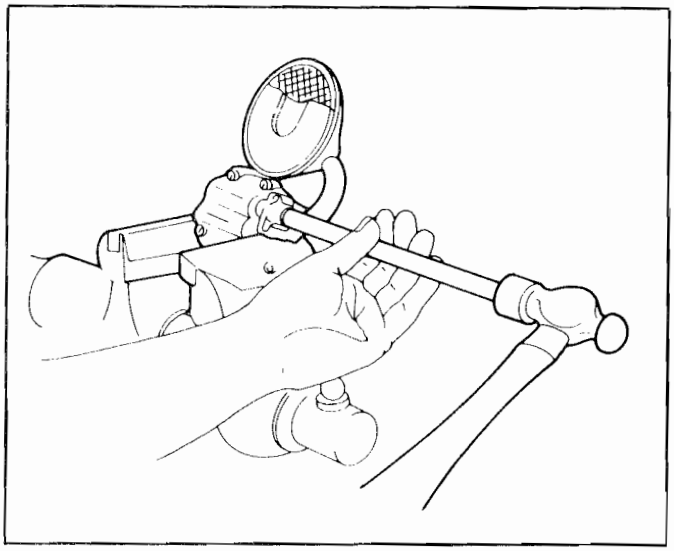


Figure 6A1-34 Installing Screen

Assembly (Figure 6A1-33)

1. If the pickup screen and pipe assembly was removed, it should be replaced with a new part. Loss of press fit condition could result in an air leak and loss of oil pressure. Mount the pump in a soft-jawed vise, apply sealer to end of pipe, and using Tool J 8369 (Figure 6A1-34) tap the pipe in place with a plastic hammer.

   NOTICE: Be careful of twisting, shearing or collapsing pipe while installing in pump.

2. Install the pressure regulator valve and related parts.
3. Install the drive gear and shaft in the pump body.
4. Install the idler gear in the pump body with the smooth side of gear towards pump cover opening.
5. Install the pump cover and torque attaching screws to specifications.
6. Turn drive shaft by hand to check for smooth operation.

Installation

1. Assemble pump and extension shaft to rear main bearing cap, aligning slot on top end of extension shaft with drive tang on lower end of distributor drive shaft.
2. Install pump to rear bearing cap bolt and torque to specifications.

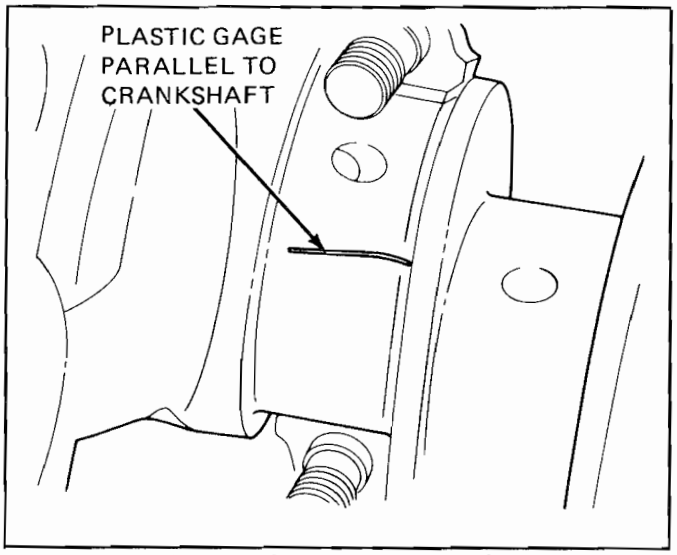


Figure 6A1-35 Gaging Plastic on Crankpin

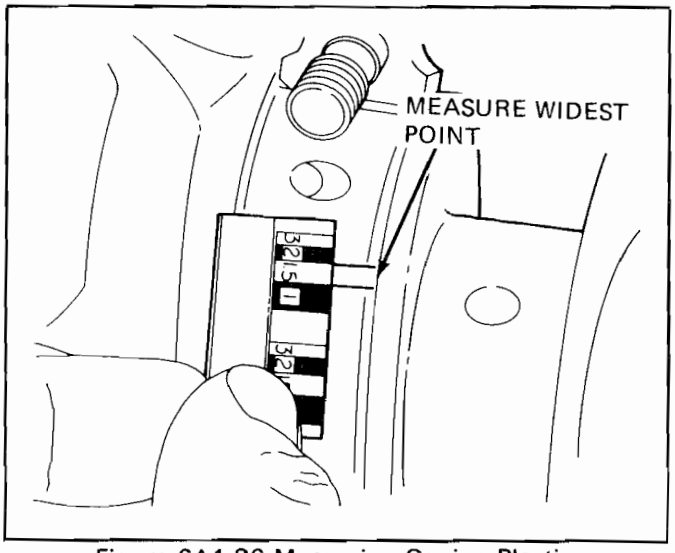


Figure 6A1-36 Measuring Gaging Plastic

3. Install oil pan previously outlined.

CONNECTING ROD BEARINGS

Connecting rod bearings are of the precision insert type and do not utilize shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are found to be excessive a new bearing will be required. Service bearings are available in standard size and .001″ and .002″ undersize for use with new and used standard size crankshafts, and in .010″ and .020″ undersize for use with reconditioned crankshafts.

On removing a connecting rod cap, it is possible to find a .010″ undersize bearing. These are used in manufacturing for selective fitting.

Inspection and Replacement

1. With oil pan and oil pump removed, remove the connecting rod cap and bearing.

   Before removal of connecting rod cap, mark the side of the rod and cap with the cylinder number to assure matched reassembly of rod and cap.

2. Inspect the bearing for evidence of wear or damage. (Bearings showing the above should not be installed.)
3. Wipe both upper and lower bearing shells and crankpin clean of oil.
4. Measure the crankpin for out-of-round or taper with a micrometer. If not within specifications replace or recondition the crankshaft. If within specifications and a new bearing is to be installed, measure the maximum diameter of the crankpin to determine new bearing size required.
5. If within specifications measure new or used bearing clearances with Plastigage or its equivalent.

   If a bearing is being fitted to an out-of-round crankpin, be sure to fit to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter and the crankpin is out-of-round .001″ interference between the bearing and crankpin will result in rapid bearing failure.

   a. Place a piece of gaging plastic, the length of the bearing (parallel to the crankshaft), on the crankpin or bearing surface. Plastic gage should be positioned in the middle of the bearing shell. (Bearings are eccentric and false readings could occur if placed elsewhere).
   b. Install the bearing in the connecting rod and cap.
   c. Install the bearing cap and evenly torque nuts to specifications.

   NOTICE: Do not turn the crankshaft with the gaging plastic installed.

   d. Remove the bearing cap and using the scale on the gaging plastic envelope, measure the gaging plastic width at the widest point.
6. If the clearance exceeds specifications, select a new, correct size, bearing and remeasure the clearance.

   Be sure to check what size bearing is being removed in order to determine proper replacement size bearing. If clearance cannot be brought to within specifications, the crankpin will have to be ground undersize. If the crankpin is already at maximum undersize, replace crankshaft.
7. Coat the bearing surface with oil, install the rod cap and torque nuts to specifications.
8. When all connecting rod bearings have been installed tap each rod lightly (parallel to the crankpin) to make sure they have clearance.
9. Measure all connecting rod side clearances (see specifications) between connecting rod caps.

MAIN BEARINGS (FIGURE 6A1-37)

Main bearings are of the precision insert type and do not utilize shims for adjustment. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Service bearings are

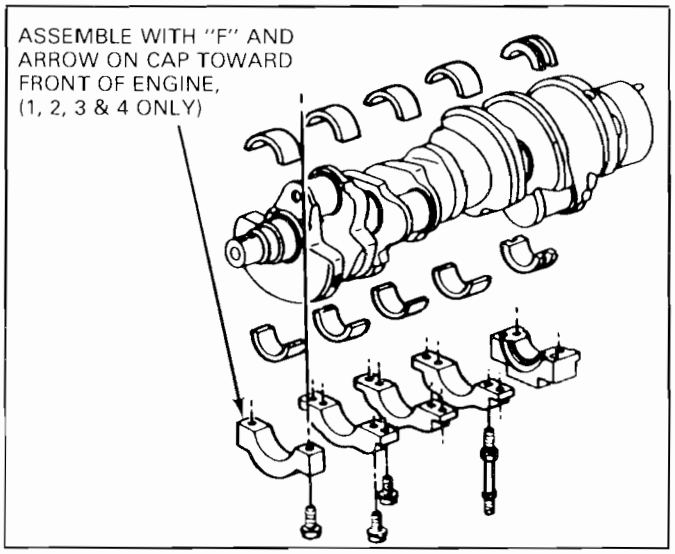


Figure 6A1-37 Main Bearings

available in standard size and .001″, .002″, .009″, .010″ and .020″ undersize.

Selective fitting of both rod and main bearing inserts is necessary in production in order to obtain close tolerances. For this reason you may find one half of a standard insert with one half of a .001″ undersize insert which will decrease the clearance .0005″ from using a full standard bearing.

When a production crankshaft cannot be precision fitted by this method, it is then ground .009″ undersize **ON ONLY THOSE MAIN JOURNALS THAT CANNOT BE PROPERLY FITTED. ALL JOURNALS WILL NOT NECESSARILY BE GROUND UNDERSIZE.** A .009″ undersize bearing and .010″ undersize bearing may be used for precision fitting in the same manner as previously described.

- The crankshaft throw will be stamped on one side of the undersize journal with "9", along with a large spot of light green paint.
- The main bearing cap is painted light green on each side of the affected journal.

  If, for any reason, main bearing caps are replaced, shimming may be necessary. Laminated shims for each cap are available for service. Shim requirement will be determined by bearing clearance.

Inspection

In general, the lower half of the bearing (except #1 bearing) shows a greater wear and the most distress from fatigue. If upon inspection the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one half without replacing the other half.

Checking Clearance

To obtain the most accurate results with "Plastigage", (or its equivalent) a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface, certain precautions should be observed.

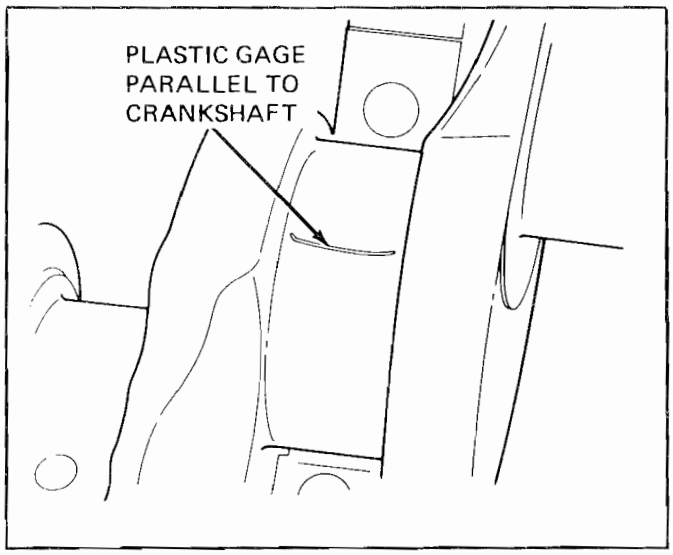


Figure 6A1-38 Gaging Plastic on Journal

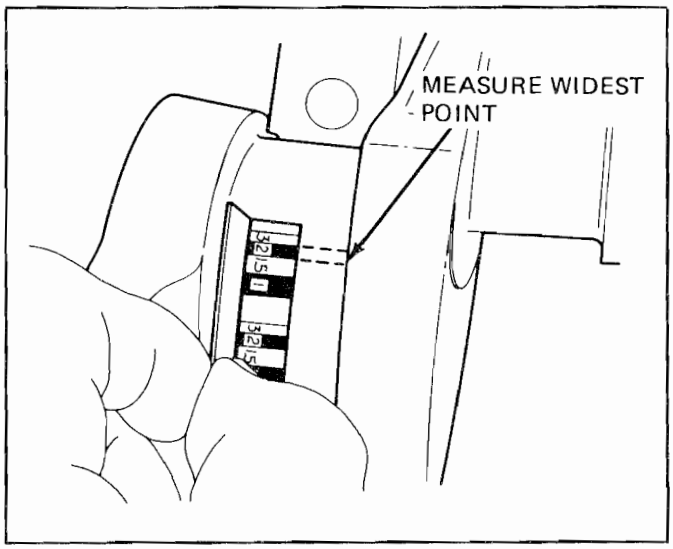


Figure 6A1-39 Measuring Gaging Plastic

If the engine is out of the vehicle and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal. If the engine is to remain in the vehicle, the crankshaft must be supported upward to remove any clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal.

To assure the proper seating of the crankshaft, all bearing cap bolts should be at their specified torque. In addition, preparatory to checking fit of bearings, the surface of the crankshaft journal and bearing should be wiped clean of oil.

1. With the oil pan and oil pump removed, and starting with the rear main bearing, remove bearing cap and wipe oil from journal and bearing cap.
2. Place a piece of gaging plastic the full width of the bearing (parallel to the crankshaft) on the journal.

NOTICE: Do not rotate the crankshaft while the gaging plastic is between the bearing and journal.

3. Install the bearing cap and evenly torque the retaining bolts to specifications. Bearing cap MUST be torqued to specification in order to assure proper reading. Variations in torque affect the compression of the plastic gage.
   Intermediate caps have four bolts. Inner bolts are torqued to 80 lb. ft. (108 N·m) while the outer bolts are torqued to 70 lb. ft. (95 N·m).
4. Remove bearing cap. The flattened gaging plastic will be found adhering to either the bearing shell or journal.
5. On the edge of gaging plastic envelope there is a graduated scale which is correlated in thousandths of an inch. Without removing the gaging plastic, measure its compressed width (at the widest point) with the graduations on the gaging plastic envelope.
   Normally main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal (.001″ max.), be sure to fit to the maximum diameter of the journal: If the bearing is fitted to the minimum diameter and the journal is out-of-round .001″, interference between the bearing and journal will result in rapid bearing failure. If the flattened gaging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to measure the journal with a micrometer if the flattened gaging plastic indicates more than .001″ difference.
6. If the bearing clearance is within specifications, the bearing insert is satisfactory. If the clearance is not within specifications, replace the insert. Always replace both upper and lower inserts as a unit.
   If a new bearing cap is being installed and clearance is less than .001″, inspect for burrs or nicks; if none are found then install shims as required.
7. A standard, .001″ or .002″ undersize bearing may produce the proper clearance. If not, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing.
   After selecting new bearing, recheck clearance.
8. Proceed to the next bearing. After all bearings have been checked rotate the crankshaft to see that there is no excessive drag.
   When checking #1 main bearing, loosen accessory drive belts so as to prevent tapered reading with plastic gage.
9. Measure crankshaft end play (see specifications) by forcing the crankshaft to the extreme front position. Measure at the front end of the rear main bearing with a feeler gage.
10. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

NOTICE: Some production engines may come with rear main bearings with the distance between thrust faces .008″ wider than the standard size. The crankshaft will be identified by .008″ stamped

on the rear counterweight. If the rear main bearings are replaced, they must have the proper distance between thrust faces to ensure correct crankshaft end play.

Replacement

Main bearings may be replaced with or without removing the crankshaft.

With Crankshaft Removal

1. Remove and inspect the crankshaft.
2. Remove the main bearings from the cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in the cylinder block and main bearing caps.
4. Install the crankshaft.

Without Crankshaft Removal

1. With oil pan, oil pump and spark plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.
2. Install a main bearing removing and installing tool in oil hole in crankshaft journal. If such a tool is not available, a cotter pin may be bent as required to do the job.
3. Rotate the crankshaft clockwise as viewed from the front of engine. This will roll upper bearing out of block.
4. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block. Rotate the bearing into place and remove tool from oil hole in crankshaft journal.
5. Oil new lower bearing and install in bearing cap.
6. Install main bearing cap with arrows pointing toward front of engine.
7. Torque all main bearing caps, EXCEPT THE REAR MAIN CAP, to specifications. Torque rear main bearing cap to 10-12 lb. ft. (14-16 N·m) then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing caps to specifications.

OIL SEAL (REAR MAIN)

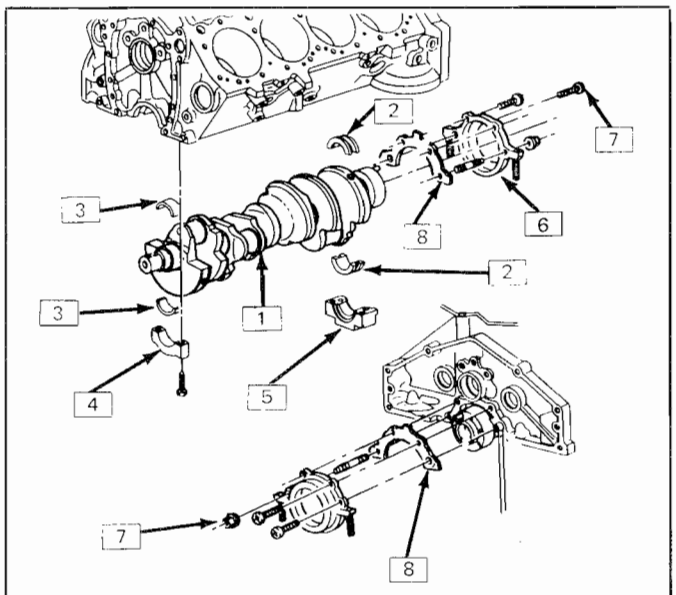
Removal

1. Remove transmission as outlined in Section 7.
2. Using notches provided in retainer, pry out seal with a screwdriver (Figure 6A1-41).

NOTICE: Care should be taken when removing the seal so as not to nick crankshaft sealing surface.

Installation

1. Lubricate the I.D. and O.D. of new seal with engine oil.
2. Install seal on tool J-35621 (Figure 6A1-42).
3. Thread screws into rear of crankshaft. Tighten screws with a screwdriver snugly, this is to insure that the seal will be installed squarely over the crankshaft.



1. CRANKSHAFT
2. THRUST BEARING
3. MAIN BEARING
4. BEARING CAP
5. REAR MAIN BEARING CAP
6. RETAINER
7. 13-16 N·m (120-150 IN. LBS.)
8. GASKET

Figure 6A1-40 Crankshaft Oil Seal-Rear Main

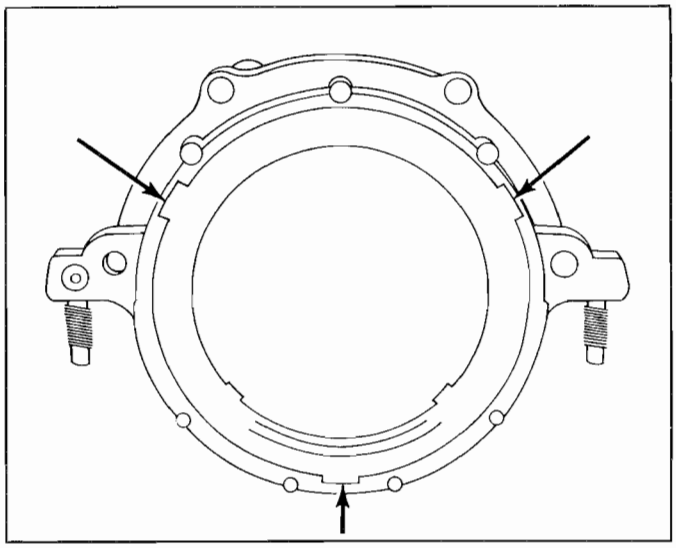


Figure 6A1-41 Seal Removal

4. Tighten the wing nut until it bottoms.
5. Remove tool from crankshaft.
6. Install transmission.

REAR MAIN SEAL RETAINER/GASKET

Removal

1. Remove transmission as outlined in Section 7.
2. Remove oil pan bolts and lower oil pan.
3. Remove studs from retainer.
4. Remove retainer and seal assembly.
5. Remove gasket.

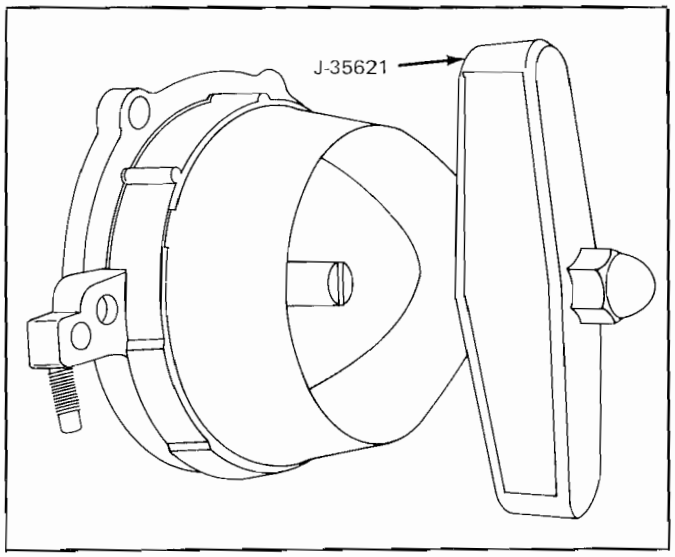


Figure 6A1-42 Installing Seal

Installation

Whenever the retainer is removed, a new retainer gasket and rear main seal must be installed.

1. Clean mating surfaces of case and retainer assembly.
2. Install new gasket on studs in engine case.
   It is not necessary to use any type of sealant to retain gasket in place.
3. Install retainer to case bolts. torque bolts to 10-13 N·m (90-120 in. lbs.).
4. Inspect oil pan gasket for damage. Replace gasket if necessary.
5. Apply 1052080 sealant or equivalent onto the two front corners where the cover meets the case and where the rear seal retainer meets the case before installing the oil pan gasket (Figure 6A1-32).

   NOTICE: Only a small amount of sealant is required. Excessive amounts of sealant may cause a problem with proper sealing of oil pan.

6. Install oil pan and gasket bolts (Figure 6A1-31).
7. Install rear main seal using tool J 35621 as previously outlined.

CONNECTING ROD AND PISTON ASSEMBLIES

Removal

1. Remove oil pan, oil pump and cylinder head as previously outlined.
2. For the cylinder being serviced, turn crankshaft until piston is at the bottom of the stroke. Place a cloth on top of the piston.
3. Use a ridge reamer to remove any ridge and/or deposits from the upper end of the cylinder bore.
4. Turn crankshaft until piston is at top of stroke and remove cloth and cuttings.
5. Remove connecting rod cap and install Tool J 5239 (3/8″) on studs. Push connecting rod and piston assembly out of top of cylinder block. It will be necessary to turn the crankshaft slightly to disconnect some of the connecting rod and piston assemblies and push them out of the cylinder.

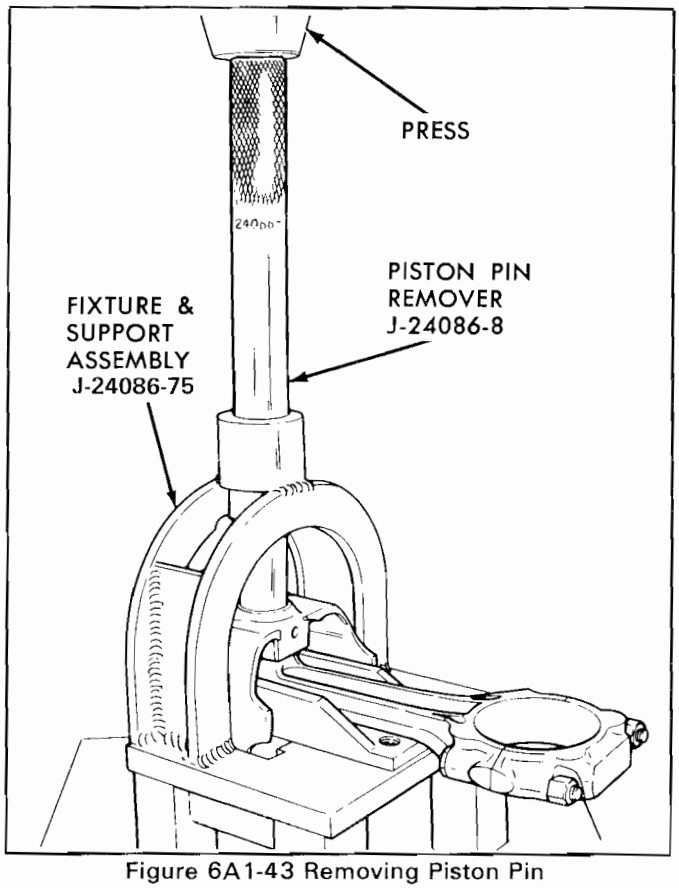


Figure 6A1-43 Removing Piston Pin

Disassembly

1. Remove connecting rod bearings from connecting rods and caps. If bearings are being reused, place them in a rack so they may be reinstalled in their original rod and cap.
2. Remove piston rings by expanding and sliding them off the pistons. Tool J 8032 (4″) is available for this purpose.
3. Place connecting rod and piston assembly on Tool J 24086-20. Using an arbor press and piston pin remover, J 24086-8, press the piston pin out of connecting rod and piston (Figure 6A1-43).

Cleaning and Inspection

Connecting Rods

Wash connecting rods in cleaning solvent and dry with compressed air. Check for twisted or bent rods and inspect for nicks or cracks. Replace connecting rods that are damaged.

Pistons

Clean varnish from piston skirts and pins with a cleaning solvent. DO NOT WIRE BRUSH ANY PART OF THE PISTON. Clean the ring grooves with a groove cleaner and make sure oil ring holes and slots are clean.

Inspect the piston for cracked ring lands, skirts or pin bosses, wavy or worn ring lands, scuffed or

damaged skirts, eroded areas at top of the piston. Replace pistons that are damaged or show signs of excessive wear.

Inspect the grooves for nicks or burrs that might cause the rings to hang up.

Measure piston skirt (across center line of piston pin) and check clearance.

Piston Pins

The piston pin clearance is designed to maintain adequate clearance under all engine operating conditions. Because of this, the piston and piston pin are a matched set and not serviced separately.

Inspect piston pin bores and piston pins for wear. Piston pin bores and piston pins must be free of varnish or scuffing when being measured. The piston pin should be measured with a micrometer and the piston pin bore should be measured with a dial bore gage or an inside micrometer. If clearance is in excess of the .001" wear limit, the piston assembly and/or piston pin should be replaced.

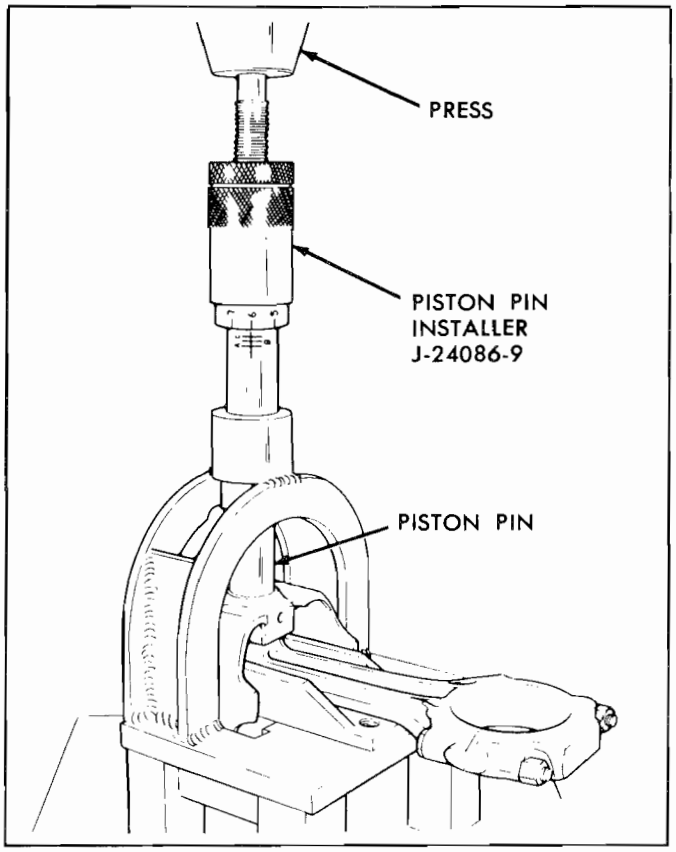


Figure 6A1-44 Installing Piston Pin

Assembly

1. Lubricate piston pin holes in piston and connecting rod to facilitate installation of pin.
2. Place connecting rod in piston and hold in place with piston pin guide and piston pin. Place assembly on fixture and support assembly.
3. Using piston pin installer, J 24086-9, press the piston pin into the piston and connecting rod (Figure 6A1-44).

NOTICE: After installer hub bottoms on support assembly, do not exceed 5000 psi pressure, as this could cause structural damage to the tool.

4. Remove piston and connecting rod assembly from tool and check piston for freedom of movement on piston pin.

Piston Rings

All compression rings are marked on the upper side of the ring. When installing compression rings, make sure the MARKED SIDE IS TOWARD THE TOP OF THE PISTON. The top ring is chrome faced, or treated with molybdenum for maximum life. The second compression ring is a tapered face acting as both a compression and oil control ring.

The oil control rings are of three piece type, consisting of two segments (rails) and a spacer.

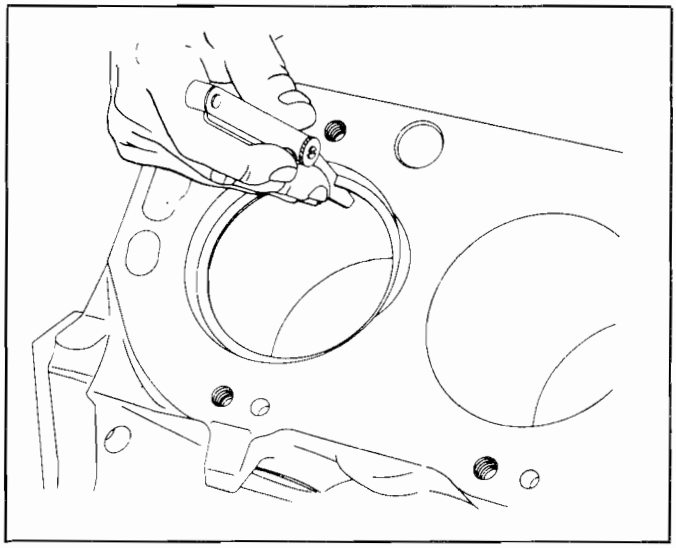


Figure 6A1-45 Measuring Ring Gap

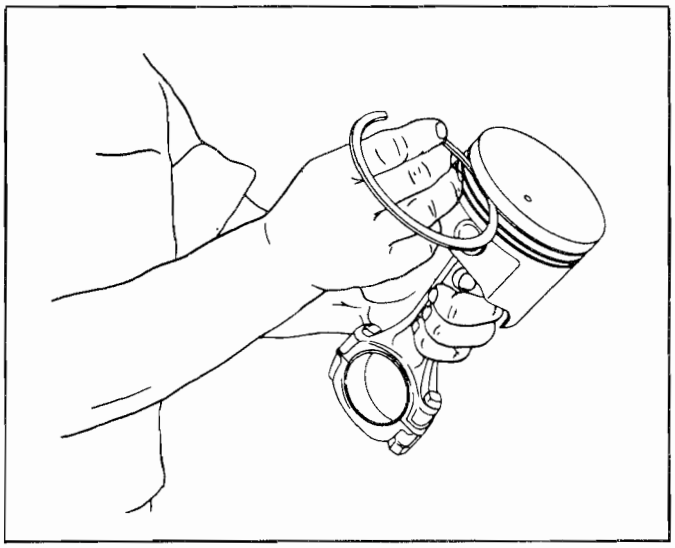


Figure 6A1-46 Checking Ring in Groove

1. Select rings comparable in size to the piston being used.
2. Slip the compression ring in the cylinder bore; then press the ring down into the cylinder bore

about 1/4" (6.5mm) (above ring travel). Be sure ring is square with cylinder wall.
3. Measure the space or gap between the ends of the ring with a feeler gage (Figure 6A1-45).
4. If the gap between the ends of the ring is below specifications, remove the ring and try another for fit.
5. Fit each compression ring to the cylinder in which it is going to be used.
6. If the pistons have not been cleaned and inspected as previously outlined, do so.
7. Slip the outer surface of the top and second compression ring into the respective piston ring groove and roll the ring entirely around the groove (Figure 6A1-46) to make sure that the ring is free. If binding occurs at any point, the cause should be determined. If binding is caused by ring groove, correct by dressing with a fine cut file. If the binding is caused by a distorted ring, check a new ring.
8. Install piston rings as follows:
   - Tool J 8032 is available for this purpose.
   a. Install oil ring spacer in groove and insert anti-rotation tang (where applicable) in drilled hole.
   b. Hold spacer ends butted and install lower steel oil ring rail with gap properly located.
   c. Install upper steel oil ring rail with gap properly located.
   d. Flex the oil ring assembly to make sure ring is free. If binding occurs at any point the cause should be determined. If binding is caused by ring groove, correct by dressing groove with a fine cut file. If binding is caused by a distorted ring, check a new ring.
   e. Install second compression ring (manufacturer mark up) with gaps properly located.
   f. Install top compression ring (manufacturer mark up) with gap properly located.

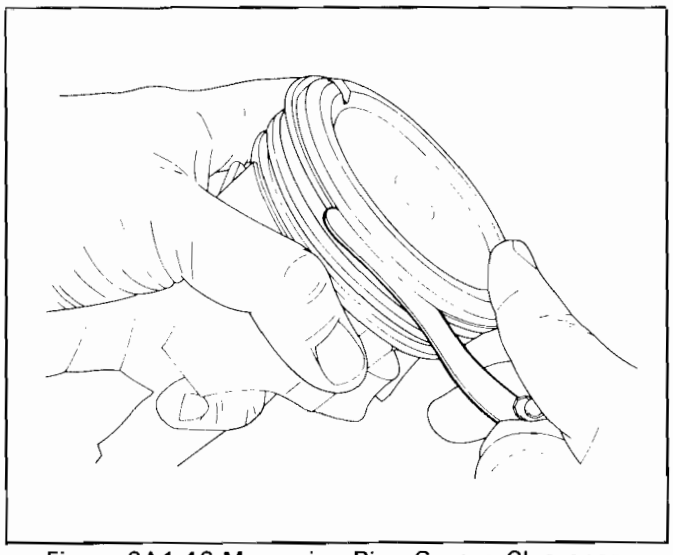


Figure 6A1-46 Measuring Ring Groove Clearance

9. Proper clearance of the piston ring in its piston ring groove is very important to provide proper ring action and reduce wear. Therefore, when fitting new rings, the clearances between the surfaces of the ring and groove should be measured (Figure 6A1-47). (See Specifications).

Installation

Cylinder bores must be clean before piston installation. This may be accomplished with a hot water and detergent wash or with a light honing as necessary. After cleaning, the bores should be swabbed several times with light engine oil and a clean dry cloth.

1. Lubricate connecting rod bearings and install in rods and rod caps.
2. Lightly coat pistons, rings and cylinder walls with light engine oil.
3. With bearing caps removed, install Tool J 5239 (3/8") on connecting rod bolts.
4. Install each connecting rod and piston assembly in its respective bore. Install with connecting rod bearing tang slots on side opposite camshaft. Use Tool J 8037 to compress the rings. Guide the connecting rod into place on the crankshaft journal with Tool J 5239 (3/8"). Use a hammer handle and light blows to install the piston into the bore. Hold the ring compressor firmly against the cylinder block until all piston rings have entered the cylinder bore.
5. Remove Tool J 5239.
6. Install the bearing caps and torque nuts to specifications.

Be sure to install new pistons in the cylinders for which they were fitted, and used pistons in the cylinder from which they were removed. Each connecting rod and bearing cap should be marked, beginning at the front of the engine. 1,3,5 and 7 in the left bank and, 2 4, 6 and 8 in the right bank. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

CYLINDER BLOCK

Cleaning and Inspection

1. Wash cylinder block thoroughly in cleaning solvent and clean all gasket surfaces.
2. Remove oil gallery plugs and clean all oil passages.
3. Clean and inspect coolant passages in the cylinder block.
4. Inspect the cylinder block for cracks in the cylinder walls, coolant jacket, valve lifter bores and main bearing webs.
5. Measure the cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator. Set the gage so that the thrust pin must be forced in about 1/4" (6.5mm) to enter gage in cylinder bore. Center gage in cylinder and turn dial to "0". Carefully work gage up and down cylinder to

determine taper and turn it to different points around cylinder wall to determine the out-of-round condition. If cylinders were found to exceed specifications, honing or boring will be necessary.

Conditioning

The performance of the following operation is contingent upon engine condition at time of repair.

If the cylinder block inspection indicated that the block was suitable for continued use except for out-of-round or tapered cylinders, they can be conditioned by honing or boring.

If the cylinders were found to have less than .005" (.13mm) taper or wear, they can be conditioned with a hone and fitted with the high limit standard size piston. A cylinder bore of less then .005" (.13mm) wear or taper may not entirely clean up when fitted to a high limit piston. If it is desired to entirely clean up the bore in these cases, it will be necessary to rebore for an oversize piston. If more than .005" (.13mm) taper or wear, they should be bored and honed to the smallest oversize that will permit. complete resurfacing of all cylinders.

When pistons are being fitted and honing is not necessary, cylinder bores may be cleaned with a hot water and detergent wash. After cleaning, the cylinder bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth.

Boring

1. Before using any type boring bar, the top of the cylinder block should be filed to remove any dirt or burrs. This is very important. If not checked, the boring bar may be tilted which would result in the rebored cylinder wall not being at right angles to the crankshaft.
2. The piston to be fitted should be measured with a micrometer, measuring at the center of the piston skirt and at right angles to the piston pin. The cylinder should be bored to the same diameter as the piston and honed to give the specified clearance.
3. The instructions furnished by the manufacturer of the equipment being used should be carefully followed.

Honing

1. When cylinders are to be honed, follow the hone manufacturer's recommendations for the use of the hone and cleaning and lubrication during honing.
2. Occasionally during the honing operation, the cylinder bore should be thoroughly cleaned and the piston selected for the individual cylinder checked for correct fit.
3. When finish honing a cylinder bore to fit a piston, the hone should be moved up and down at a sufficient speed to obtain very fine uniform surface finish marks in a cross-hatch pattern of approximately 45° to 65° included angle. The finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal.
4. Permanently mark the piston for the cylinder to which it has been fitted and proceed to hone cylinders and fit the remaining pistons.

NOTICE: Handle the pistons with care and do not attempt to force them through the cylinder until the cylinder has been honed to correct size as this type piston can be distorted through careless handling.

5. Thoroughly clean the bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any of the abrasive material is allowed to remain in the cylinder bores, it will rapidly wear the new rings and cylinder bores in addition to the bearings lubricated by the contaminated oil, the bores should be swabbed and then wiped with a clean dry cloth. Cylinder should not be cleaned with kerosene or gasoline. Clean the remainder of the cylinder block to remove the excess material spread during the honing operation.

Piston Selection

1. Check USED piston to cylinder bore clearance as follows:
   a. Measure the "Cylinder Bore Diameter" with a telescope gage "2-1/2" (64mm) from top of cylinder bore").
   b. Measure the "Piston Diameter" (at skirt across center line of piston pin).
   c. Subtract piston diameter from cylinder bore diameter to determine "Piston to Bore Clearance".
2. If used piston is not acceptable, determine if a new piston can be selected to fit cylinder bore within the acceptable range.
3. If cylinder bore must be reconditioned, measure new piston diameter (across center line of piston pin) then hone cylinder bore to correct clearance (preferable range).
4. Mark the piston to identify the cylinder for which it was fitted.

OIL FILTER BYPASS VALVE

Inspection and Replacement

With the oil filter removed, check the spring and fibre valve for operation. Inspect for a cracked or broken valve. If replacement is necessary, the oil filter adapter and bypass valve assembly must be replaced as an assembly. Clean valve chamber in cylinder block thoroughly. Torque retaining screws to specifications.

ENGINE ASSEMBLY

Removal

1. Disconnect battery.

2. Disconnect accelerator and cruise control cables at engine.
3. Remove plenum extension.
4. Disconnect plug wires at distributor cap.
5. Remove distributor cap.
6. Remove distributor.
7. Remove cowl screen.
8. Remove nut from wiper motor arm.
9. Disconnect wiper motor wires and remove wiper motor cover.
10. Remove wiper motor.
11. Remove air intake duct with MAF sensor.
12. Disconnect brake booster vacuum hose.
13. Disconnect canister hose at PCV pipe.
14. Disconnect vacuum hose at intake.
15. Disconnect necessary wires at engine.
16. Disconnect necessary vacuum hose at engine.
17. Disconnect injection harness at intake.
18. Drain cooling system.
19. Disconnect heater hoses at pipe.
20. Disconnect upper radiator hose at housing.
21. Remove serpentine belt.
22. Relieve fuel pressure.
23. Disconnect fuel lines at fuel rail.
24. Disconnect AIR switching valve at A/C compressor.
25. Remove catalytic converter AIR pipe.
26. Disconnect A/C brace at exhaust manifold.
27. Remove A/C bracket nuts at water pump.
28. Loosen upper A/C bracket bolts.
29. Loosen A/C lower mount bolt.
30. Disconnect accumulator at fan shroud and brace.
31. Disconnect fuel lines at block.
32. Disconnect lower radiator hose at water pump.
33. Disconnect heater hose at water pump.
34. Remove fuel lines from A/C bracket and wire compressor aside.
35. Remove alternator.
36. Remove AIR pump with bracket.
37. Disconnect P/S reservoir at fan shroud and brace.
38. Disconnect P/S pump at engine and wire aside.
39. Remove water pump pulley.
40. Remove crankshaft pulley.
41. Raise vehicle.
42. Disconnect wires at oxygen sensor, ESC sensor and temperature sensor.
43. Disconnect temperature sensor wire at block.
44. Disconnect ground wires at block.
45. Disconnect catalytic converter AIR pipe at manifold.
46. Disconnect transmission cooler lines at flywheel cover.
47. Disconnect wires at starter.
48. Remove starter.
49. Disconnect exhaust pipe at manifolds.
50. Drain engine oil.
51. Remove oil filter.
52. Disconnect oil cooler adapter at block.
53. Remove flywheel cover.
54. Disconnect oil cooler line at oil pan.
55. Disconnect exhaust at converter hanger.
56. Remove engine mount through bolts.
57. Remove engine mount to block bolts.
58. Remove bellhousing bolts.
59. Lower vehicle.
60. Support transmission with jack.
61. Install lifting device.
62. Remove engine.

Installation

For installation, reverse removal procedures.

CRANKSHAFT

The crankshaft can be removed while the engine is disassembled for overhaul, as previously outlined, or without complete disassembly.

Removal

1. With the engine removed from the vehicle and the transmission and/or clutch housing removed from the engine, mount engine in stand and clamp securely.
2. Remove the oil dip stick and oil dip stick tube, (if necessary).
3. Remove the starting motor, clutch assembly (if equipped) and flywheel.
4. Remove the spark plugs.
5. Remove crankshaft pulley and torsional damper.
6. Remove oil pan and oil pump.
7. Remove crankcase front cover and timing chain and camshaft sprocket.
8. Check the connecting rod caps for cylinder number identification. If necessary, mark them.
9. Remove the connecting rod caps and push the pistons to top of bores.
10. Remove main bearing caps and lift crankshaft out of cylinder block.
11. Remove rear main bearing oil seal and main bearings from cylinder block and main bearing caps.

Cleaning and Inspection

1. Wash crankshaft in solvent and dry with compressed air.
2. Measure dimensions of main bearing journals and crankpins with a micrometer for out-of-round, taper or undersize. (See Specifications.)
3. Check crankshaft for run-out by supporting at the front and rear main bearings journals in "V" blocks and check at the front and rear intermediate journals with a dial indicator. (See Specifications.)
4. Replace or recondition the crankshaft if out of specifications.

SPROCKET OR GEAR REPLACEMENT

- Remove crankshaft sprocket using Tool J 5825, install using Tool J 5590.

Installation

1. Install rear main bearing oil seal in cylinder block and rear main bearing cap grooves. Install with lip of seal toward front of engine. Where seal has two lips install lip with helix towards front of engine.
2. Lubricate lips of seal with engine oil. Keep oil off parting line surface.
3. Install main bearings in cylinder block and main bearing caps, then lubricate bearing surface with engine oil.
4. Install crankshaft, being careful not to damage bearing surfaces.
5. Apply a thin coat of brush-on type oil sealing compound to block mating surface and corresponding surface of cap only. Do not allow sealant on crankshaft or seal.
6. Install main bearing caps with arrows pointing toward front of engine.
7. Torque all except rear main bearing cap bolts to specifications. Torque rear main bearing cap bolts to 10-12 lbs. ft. then tap end of crankshaft. first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing cap bolts to specifications.
8. Measure crankshaft end play with a feeler gage. Force crankshaft forward and measure clearance between the front of the rear main bearing and the crankshaft thrust surface.
9. Install flywheel and torque to specifications. A wood block placed between the crankshaft and cylinder block will prevent crankshaft from rotating.
   - Align dowel hole in flywheel with dowel hole in crankshaft. On vehicles equipped with automatic transmissions, install flywheel with the converter attaching pads towards transmission.

GENERAL DATA

TYPE	90° V-8
DISPLACEMENT	350 Cu. In.
LITER (VIN)	5.7 (8)
RPO	L98
BORE	4.000
STROKE	3.480
COMPRESSION RATIO	9.0:1
FIRING ORDER	1-8-4-3-6-5-7-2

Cylinder Bore

DIAMETER	3.9995-4.0025
OUT-OF-ROUND	
Production	.0010 Max.
Service	.0020 Max.
TAPER	
Production Thrust Side	.0005 Max.
Production Relief Side	.0010 Max.
Service	.0010 Max.

Piston

CLEARANCE	
Production	.0007-.0017
Service	.0025 Max.

Piston Ring

COMPRESSION	
Groove Clearance	
Production 1st	.0012-.0029
Production 2nd	.0012-.0029
Service	Hi Limit Production + .001
Gap	
Production 1st	.010-.020
Production 2nd	.013-.025
Service	Hi Limit Production + .010
OIL	

Groove Clearance
Production ..... .002-.008
Service ..... Hi Limit Production + .001
Gap
Production ..... .015-.055
Service ..... Hi Limit Production + .010

Piston Pin

DIAMETER ..... .9271-.9269
CLEARANCE ..... .0002-.0007
Production ..... .00025-.00035
Service ..... .001 Max.
FIT IN ROD ..... .0008-.0016 Interference

Crankshaft

MAIN JOURNAL
Diameter
#1 ..... 2.4484-2.4493
#2-3-4 ..... 2.4481-2.4490
#5 ..... 2.4479-2.4488
Taper
Production ..... .0002 Max.
Service ..... .0010 Max.
Out-Of-Round
Production ..... .0002 Max.
Service ..... .0010 Max.
MAIN BEARING CLEARANCE
Production
#1 ..... .0008-.0020
#2-3-4 ..... .0011-.0023
#5 ..... .0017-.0032
Service
#1 ..... .001-.0015
#2-3-4 ..... .001-.0025
#5 ..... .0025-.0035
CRANKSHAFT END PLAY ..... .002-.006
CRANKPIN
Diameter 2.0988-2.0998
Taper
Production ..... .0003 Max.
Service ..... .001 Max.
Out-Of-Round
Production ..... .0002
Service ..... .0010 Max.
ROD BEARING CLEARANCE
Production ..... .0013-.0035
Service ..... .0035 Max.
ROD SIDE CLEARANCE ..... .006-.014

Camshaft

LOBE LIFT ± .002
Intake ..... .2733
Exhaust ..... .2820
JOURNAL DIAMETER 1.8682-1.8692
CAMSHAFT END PLAY ..... .004-.012

Valve System

LIFTER	Hydraulic
ROCKER ARM RATIO	1.50:1
VALVE LASH	
Intake	One Turn Down
Exhaust	From Zero Lash
FACE ANGLE	45°
SEAT ANGLE	46°
SEAT RUNOUT	.002 Max.
SEAT WIDTH	
Intake	1/32-1/16
Exhaust	1/16-3/32
STEM CLEARANCE	
Production	
Intake	.0010-.0027
Exhaust	.0010-.0027
Service	Hi Limit Production + .001 Intake + .002 Exhaust
VALVE SPRING	
Free Length	2.03
Pressure Lbs. @ In.	
Closed	76-84 @ 1.70 INT., 1.61 EXH.
Open	194-206 @ 1.25 INT., 1.16 EXH.
Installed Height	1-23/32 INT., 1-19/32 EXH.
DAMPER	
Free Length	1.86
Approx. # of Coils	4

TORQUE SPECIFICATIONS

Crankcase Front Cover	9 N·m (80 lb. in.)
Flywheel Housing Cover	9 N·m (80 lb. in.)
Oil Filter Bypass Valve	9 N·m (80 lb. in.)
Oil Pan to Crankcase (1/4-20)	11 N·m (100 lb. in.)
Oil Pump Cover	9 N·m (80 lb. in.)
Rocker Arm Cover	11 N·m (100 lb. in.)
Camshaft sprocket	27 N·m (20 lb. ft.)
Oil Pan to Crankcase Nuts	22 N·m (200 lb. in.)
Oil Pan Studs To Crankcase at Corners	2 N·m (15 lb. in.)
Oil Pan Studs - Pan to Case	11 N·m (100 lb. in.)
Clutch Pressure Plate	40 N·m (30 lb. ft.)
Distributor Clamp	34 N·m (25 lb. ft.)
Flywheel Housing	40 N·m (30 lb. ft.)
Manifold (Exhaust)	27 N·m (20 lb. ft.)
Manifold (Inlet)	47 N·m (35 lb. ft.)
Water Outlet	27 N·m (20 lb. ft.)
Water Pump	40 N·m (30 lb. ft.)
Connecting Rod Cap	60 N·m (45 lb. ft.)
Cylinder Head	88 N·m (65 lb. ft.)
Main Bearing Cap	108 N·m (80 lb. ft.)
Oil Pump	88 N·m (65 lb. ft.)
Rocker Arm Stud	68 N·m (50 lb. ft.)
Flywheel	81 N·m (60 lb. ft.)
Torsional Damper	81 N·m (60 lb. ft.)
Oil Pan Drain Plug	27 N·m (20 lb. ft.)
Spark Plug	30 N·m (22 lb. ft.)

SECTION 6B

ENGINE COOLING

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GENERAL DESCRIPTION

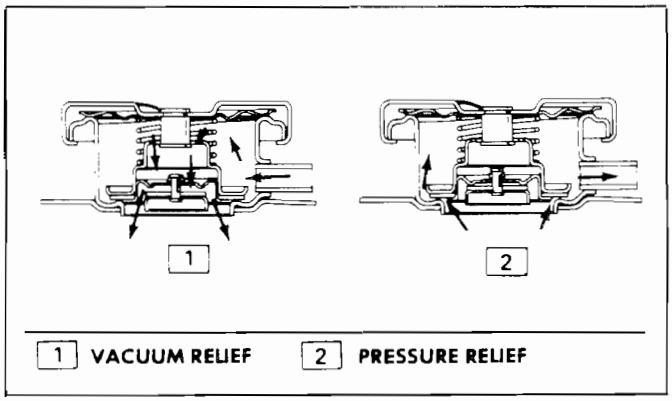


Figure 6B-1 Radiator Pressure Cap

All Chevrolet Corvettes have pressure type engine cooling systems with thermostatic control of coolant circulation. The cooling system is sealed by a pressure type radiator filler cap which causes the system to operate at higher than atmospheric pressure. The higher pressure raises the boiling point of the coolant which increases the cooling efficiency of the radiator. The 15 pound (103 kPa) pressure cap used raises the boiling point of coolant to approximately 262°F (128°C) at sea level.

The radiator cap should be washed with clean water and pressure checked every 12 months.

All models have a closed cooling system using a round pressure cap (Figure 6B-1) and a coolant reservoir. Coolant can be added without removing the radiator cap.

A pressure-vacuum valve radiator cap is used which allows the coolant to expand through the pressure valve in the center of the cap without building unnecessary pressure. The expanding coolant flows into the coolant reservoir. The vent valve closes due to expansion and coolant flow. The nominal 15 pound (103 kPa) pressure will not be reached until the system is working at maximum capacity.

Any air or vapor in the cooling system will be forced to the coolant reservoir under the liquid level and leave through the vent on the cap of the reservoir. As the system cools, the extra coolant in the reservoir will be drawn back to the radiator through the vent valve. In this manner, the radiator will keep itself full at all times.

COOLANT LEVEL

The need for additional coolant can be detected by observing the level of coolant in the reservoir while the engine is at normal operating temperature.

The recovery bottle coolant level can be checked using the dipstick built into the bottle cap. When engine is cold, the coolant should be at or slightly above the cold mark; tank approximately 1/4 full. When engine is fully warmed up, the coolant level should be at or slightly above hot mark; tank approximately 1/2 full. The radiator cap need not normally be removed.

The coolant level should be at the "Full Cold" mark when the system is cool and at ambient temperature. After the vehicle has been driven sufficiently to obtain normal operating temperatures, the level should be at approximately the "Full Hot" mark.

Periodically, the radiator cap should be removed to observe coolant level in the radiator.

CAUTION: As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution in the radiator without causing the solution to boil. Removal of the radiator cap while engine is hot and pressure is high will cause the solution to boil instantaneously and possibly with explosive force, spewing the solution over engine, fenders and person removing cap. If the solution contains flammable anti-freeze such as alcohol (not recommended for use at any time), there is also the possibility of causing a serious fire.

Coolant levels in crossflow radiator with coolant recovery bottles should be maintained to the top of the filler neck of the radiator.

The recovery bottle should be at its appropriate mark when checked.

Regardless of whether freezing temperatures are expected or not, cooling system protection should be maintained at least to -34°F (-37°C), to provide adequate corrosion protection and loss of coolant from boiling. With glycol content less than requirment for -34°F (-37°C) protection, coolant boiling point is less than the temperature indicating light setting. When adding solution due to loss of coolant for any reason or in areas where temperatures lower than -34°F (-37°F) may occur, a sufficient amount of an ethylene glycol base anti-freeze that meets GM Specification 1825-M should be used.

MAINTENANCE

COOLING SYSTEM CARE

The radiator cap should not be removed to check coolant level. Check the coolant level visually in the see through coolant recovery tank everytime hood is up. Level should be near "ADD" mark when the system is cold. At normal operating temperature, the coolant level should increase to the "FULL" mark on the recovery tank. Coolant should be added only to the reservoir to raise level to the "FULL" mark. Use a 50/50 mixture of high-quality ethylene glycol anti-freeze and water for coolant additions.

NOTICE: If recommended quality anti-freeze is used supplemental inhibitors or additives claiming to provide increased cooling capability are not necessary. They may be detrimental to the efficient operation of the system, and represent unnecessary operating expenses.

The cooling system should be serviced as follows:

1. Wash radiator cap and filler neck with clean water.
2. Check coolant for proper level and freeze protection.
3. Pressure test system and radiator cap for proper pressure holding capacity 103 kPA (15 psi). If replacement of cap is required, use the proper cap specified for car model.
4. Tighten hose clamps and inspect all hoses. Replace hoses whenever cracked, swollen or otherwise deteriorated.
5. Clean frontal area of radiator core and air conditioning condenser.

DRAINING AND REFILLING

The cooling system should be flushed and refilled using the following recommended procedure:

1. Remove radiator cap when engine is cool by:
   - Slowly rotating cap counterclockwise to detent. (Do not press down while rotating).
   - Wait until any residual pressure (indicated by a hissing sound) is relieved.
   - After all hissing ceases, press down on cap while continuing to rotate counterclockwise.

CAUTION: To avoid the danger of being burned, do not remove radiator cap while engine and radiator are still hot, scalding fluid and steam may be blown out under pressure.

2. Open radiator drain valve and block drain plugs to drain coolant.
3. Close valve, install block drain plugs, and add sufficient water to fill system.
4. Run engine, drain and refill the system, as described in Steps 1, 2 and 3, a sufficient number of times until the drained liquid is nearly colorless.
5. Allow system to drain completely and then close radiator drain valve tightly, and install block drain plugs.
6. Remove recovery cap leaving hoses in place. Remove coolant recovery tank and empty fluid. Flush tank with clean water, drain and reinstall.
7. Add sufficient ethylene glycol coolant, meeting GM specifications, 1825-M. Fill radiator to the base of the radiator fill neck and add sufficient coolant to the recovery tank to raise level of the "FULL" mark. Reinstall recovery tank cap.
8. Run engine, with radiator cap removed, until normal operating temperature is reached. (Radiator upper hose becomes hot).
9. With engine idling, add coolant until level reaches bottom of filler neck and install radiator cap making certain arrows line up with overflow tube.

It is the owner's responsibility to keep the freeze protection at a level proportionate with the temperatures which may occur in the area of vehicle operation.

- Maintain cooling system freeze protection at -37°C (-34°F) to ensure protection against corrosion and loss of coolant from boiling even though freezing temperatures are not expected.
- Add ethylene glycol base coolant that meets GM Specifications 1825-M when coolant additions are required because of coolant loss or to provide additional protection against freezing at temperatures lower than -37°C (-34°F).

NOTICE: Alcohol or methanol base coolants or plain water are not recommended at any time.

NOTICE: Adding anti-freeze to prevent the coolant from boiling too soon is permissible but too much will affect the freezing point. A solution stronger than 70% anti-freeze should never be used, as the freeze level rises rapidly after this point. Pure anti-freeze will freeze at -8 degrees F (-20°F).

DIAGNOSIS

If the cooling system requires frequent addition of coolant in order to maintain the proper level, check all units and connections in the cooling system for evidence of leakage. Inspection should be made with cooling system cold. Small leaks which may show dampness or dripping can easily escape detection when the engine is hot, due to the rapid evaporation of coolant. Tell-tale stains of grayish white or rusty color, or dye stains from anti-freeze, at joints in cooling system are almost always sure signs of small leaks even though there appears to be no damage.

Air may be drawn into the cooling system through leakage at the water pump seal or through leaks on the coolant recovery system. Gas may be forced into the cooling system through leakage at the cylinder head gasket(s) even though the leakage is not sufficient to allow coolant to enter the combustion chamber.

SYSTEM CHECKS

Exhaust Leaks

To check for exhaust leaks into the cooling system, drain the system until the coolant level stands just above the top of the cylinder head(s), then disconnect the radiator upper hose and remove the thermostat and accessory belt. Start the engine and quickly accelerate several times. At the same time, note any appreciable coolant rise or the appearance of bubbles which are indicative of exhaust gases leaking into the cooling system.

NOTICE: A defective head gasket may allow exhaust gases to leak into the cooling system. This is particularly damaging to the cooling system as the gases combine with the water to form acids which are harmful to the radiator and engine.

Water Pump

Water pump operation may be checked by running the engine while squeezing the radiator upper hose (engine warm). A pressure surge should be felt. Check for a plugged venthole in pump if surge is not felt.

Radiator

Test for restriction in the radiator by warming the engine up, turning the engine off, and then feeling the radiator. The radiator should be hot along the left side and warm along the right side, with an even temperature rise from right to left. Cold spots in the radiator indicate clogged sections.

Thermostat

An operational check of the thermostat can be made by hanging the thermostat on a hook in a 33% glycol solution 22°F above the temperature stamped on the thermostat valve. Submerge the valve completely and agitate the solution thoroughly. Under this condition the valve should open. Remove the thermostat and place in a 33% glycol solution 10°F below temperature indicated on the valve. With valve completely submerged and coolant agitated thoroughly, the valve should close completely.

Overheat and/or Noise

Engine overheat and/or cooling system noise may be caused by restrictions in the cooling system.

Components which may be prone to this condition are cylinder head, water pump, block, thermostat housing and inlet manifold. Symptoms of this condition are as follows:

- Engine may make snapping/cracking noises.
- Heater core may gurgle or surge.
- Radiator hoses may collapse and expand.
- Heater hoses may vibrate and thump.
- Overheat light may or may not come on.

Symptoms are the result of coolant boiling at some localized area and may be noticed after extending idling and/or while being driven. Determine which side of the engine is involved and whether it is more at the front or rear of engine.

Inspection

1. Isolate area of engine the localized boiling is originating from. This can be done by probing engine with a sounding bar (large screwdriver).
2. With radiator cap removed, observe water being circulated in radiator. Feel the front area of radiator for cold spots which indicate blockage. Blocked radiators generally occur on units that have accrued miles and not on new vehicles.

   CAUTION: The radiator cap should be removed from a cool engine only. If the radiator cap is removed from a hot cooling system serious personal injury may result.
3. Inspect thermostat to see if it opens completely.
4. Inspect thermostat housing to make sure it is completely free of obstructions.
5. Remove water pump from vehicle and remove the back cover on the pump. All internal passages can be inspected using a flashlight.
6. Inspect crossover at the front of the inlet manifold. This entire passage can be seen with only the thermostat removed.
7. Remove heads, but lay them aside for now and check the block first because the heads are the most complex pieces as far as coolant passages are concerned.
8. With water pump and heads removed, ALL coolant passages CAN be inspected by using a penlight flashlight. All water jacket areas can be seen directly and a block should never be replaced as being suspect unless the restricted area can be DIRECTLY SEEN.
9. If none of the above inspections reveal the problem area, the heads must be considered prime suspect. Heads with blocked coolant passages generally have more than one area that is blocked. Inspect the heads for signs of overheat

discoloration (a dark blue or black area). If none are found look in the coolant passages for blockage and probe all passages that are accessible.

The head is very intricate and all passages cannot be reached. Use a probe that is fairly substantial as a tag wire may go through or around a partially blocked area. If nothing is found by visual inspection and probing, inspect the passages for a rough ragged appearance. The roughest internal passages are probably the ones that are blocked.

Replace a blocked or suspect head and inspect the replacement head in the same manner before installing it.

COOLING SYSTEM DIAGNOSIS

TO AVOID NEEDLESS TIME AND COST IN DIAGNOSING COOLING SYSTEM COMPLAINTS, THE CUSTOMER SHOULD BE QUESTIONED ABOUT DRIVING CONDITIONS THAT PLACE ABNORMAL LOADS ON THE COOLING SYSTEM.

1. DOES OVERHEATING OCCUR WHILE PULLING A TRAILER?

   If answer is "Yes" – how heavy trailer? If trailer weight is greater than 1,000 lbs. and car is equipped with normal duty cooling system, a heavy duty cooling package is required (per trailer hauling specs.). Further diagnostic checks should not be required.

2. IS CAR EQUIPPED WITH ADD – ON OR AFTER MARKET AIR CONDITIONING SYSTEM?

   If answer is "Yes" – was heavy duty radiator installed with the system? If not, install heavy duty air conditioning radiator for the car model involved. Further diagnostic checks should not be required.

3. IS OVERHEATING OCCURRING AFTER PROLONGED IDLE IN GEAR, A/C SYSTEM OPERATING?

   If answer is "Yes" – instruct owner on driving techniques that would avoid overheating, such as:
   a. Idle in Neutral as much as possible
   b. Turn A/C system off during extended idles if overheating is indicated by hot light or temperature gage.
   Further diagnostic checks should not be required.

4. IS OVERHEATING OCCURRING AFTER PROLONGED DRIVING IN SLOW CITY TRAFFIC, TRAFFIC JAMS, PARADES, ETC?

   If answer is "Yes" – instruct owner on driving techniques that would avoid overheating – same as for prolonged idles – No. 3. Further diagnostic checks should not be required.

IF NONE OF THE ABOVE APPLY, REFER TO CHARTS.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine overheats (Engine Temp. light comes on and stays on, or Temp. Gage shows hot, or coolant overflows from reservoir onto ground while engine is running.)	Loss of coolant.	See "Loss of Coolant" condition below.
	Loss of system pressure.	Pressure check with BT-7002-3 or J-24460-01 with J-23699. Correct as necessary.
	Low coolant protection (should be -35°.)	Test solution.
	Belt tension too low.	Check with BT-7825 – Adjust if loose, or replace tensioner.
	Ignition timing retarded.	Set timing to specifications. Check neutral/park switch adj.
	Timing retarded by malfunctioning Computer Command Control System.	Check and correct. See Section 6E.
	Radiator fins obstructed.	Remove or relocate added-on parts that block air to radiator, clean away bugs, leaves, etc.
	Cooling system passages blocked by rust or scale.	Flush system - add fresh coolant.
	Reservoir hose pinched or kinked (especially at radiator filler neck.)	Relieve kinks by re-routing. Replace hose if necessary.
	Cooling fan inoperative	See "Electrical Diagnosis".

Cooling Diagnosis (1 of 2)

CONDITION	POSSIBLE CAUSE	CORRECTION
	Loose, damaged and/or missing air seals or deflector.	Repair or replace as required.
	Thermostat stuck in closed position.	Replace thermostat.
	Malfunctioning water pump (eroded or broken impeller blades).	Replace water pump.
	Incorrect radiator.	Check current parts catalog and if needed, replace.
Loss of coolant.	Leaking radiator.	Inspect radiator.
	Radiator cap defective, or filler neck distorted.	Inspect cooling system and pressure check with BT-7002-3 or J-24460-01 with J-23699. Replace parts as required.
	Leaking coolant reservoir or hose.	Replace reservoir or hose.
	Loose or damaged hoses or connections.	Reseat or replace hoses or clamps.
	Water pump seal leaking.	Replace water pump.
	Water pump gasket leaking.	Replace gasket.
	Improper cylinder head bolt torque.	Torque bolts or replace cylinder head gasket(s) if required.
	Leaking intake manifold or cylinder head or gaskets, cylinder head or block core plug, heater core (or heater water valve where used).	Repair or replace as necessary to correct leak.
Engine fails to reach normal operating temperature. (Cool air from heater.)	Thermostat stuck open or wrong type thermostat.	Install new thermostat of correct type and heat range.
	Coolant below add mark.	Add coolant. (Coolant/water solution, see section OB for requirements.)
Hot Light "ON", no loss of coolant.	Defective engine temperature switch or circuit.	"Electrical Diagnosis".

Cooling Diagnosis (2 of 2)

ON-VEHICLE SERVICE

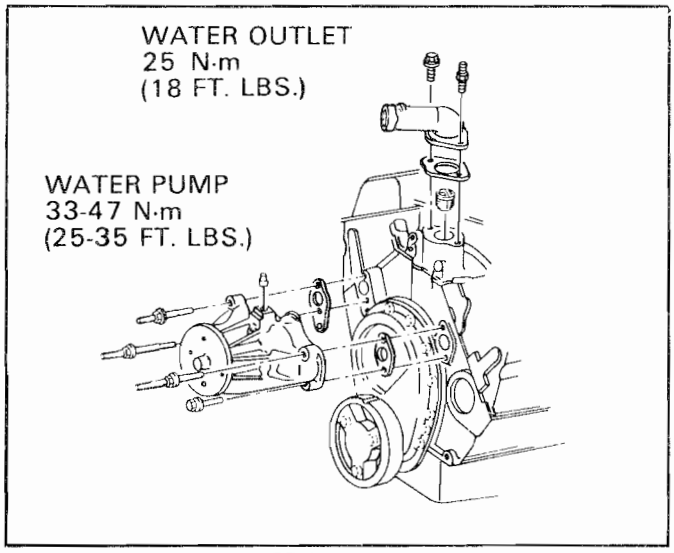


Figure 6B-2 Water Pump

WATER PUMP (FIGURE 6B-2)

Removal

1. Disconnect battery negative cable.
2. Drain cooling system.
3. Remove drive belt.
4. Remove water pump pulley.
5. Remove AIR pump pulley.
6. Remove air management valve adapter.
7. Remove AIR pump.
8. Disconnect fuel inlet and return lines.
9. Remove rear A/C compressor braces.
10. Remove lower A/C compressor mounting bolt.
11. Remove A/C compressor and idler pulley bracket nuts.
12. Disconnect A/C compressor wires.
13. Slide mounting bracket forward and rear A/C compressor bolt.
14. Remove A/C compressor.
15. Remove right and left AIF hoses at check valve.
16. Remove AIR pipe at intake and power steering reservoir bracket.
17. Remove power steering reservoir bracket including top alternator bolt.
18. Remove lower AIR bracket on water pump.
19. Remove lower radiator and heater hose at water pump.
20. Remove water pump.

Installation

If installing new water pump, transfer heater hose fitting from old unit.

1. With clean sealing surfaces on both block and water pump, install water pump to block with new gaskets and retain with attaching bolts. Torque to 33-47 N·m (25-35 ft. lbs.).
2. Reverse removal procedures for the remaining installation steps.

THERMOSTAT (FIGURE 6B-3)

Removal

1. Disconnect battery negative cable at battery.
2. Remove air cleaner.
3. Drain cooling system.
4. Remove upper radiator hose from outlet.
5. Remove thermostat housing attaching bolts and remove housing. Remove thermostat from manifold.

Installation

Prior to installing thermostat, make sure housing and manifold sealing surfaces are clean.

1. Place a 1/8″ (3mm) bead of RTV sealant, #1052366 or equivalent, all around the thermostat housing sealing surface on the intake manifold.
2. Place thermostat in intake manifold.
3. Install thermostat housing while RTV is still wet. Torque reraining bolts to 24-31 N·m (18-23 ft. lbs.).
4. Install air cleaner.
5. Connect battery negative cable.
6. Fill cooling system.
7. Start engine and run, with radiator cap removed, until radiator upper hose becomes hot (thermostat open).
8. With engine idling, add collant to radiator until level reaches bottom of filler neck.
9. Install cap, making sure arrows line up with overflow tube.

RADIATOR (FIGURE 6B-4)

Removal

1. Disconnect battery negative cable.
2. Drain cooling system.
3. Remove upper radiator hose.

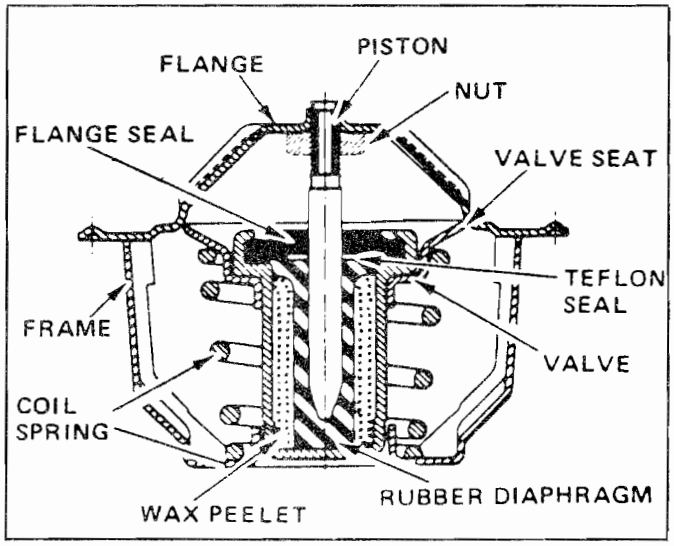


Figure 6B-3 Thermostat

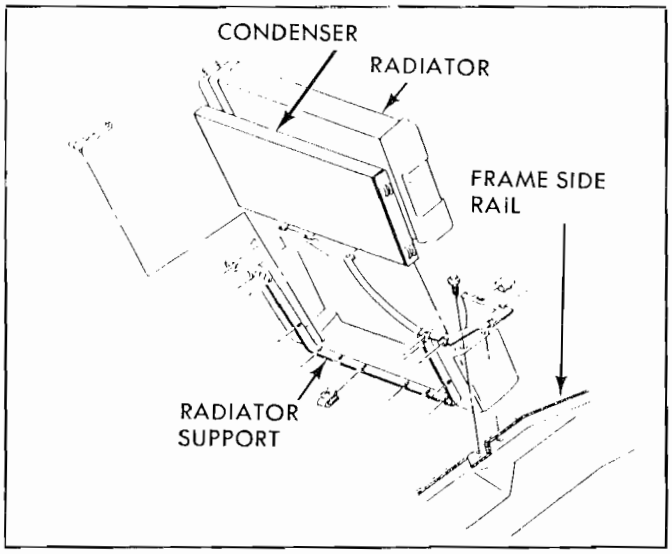


Figure 6B-4 Radiator Mounting

4. Remove lower radiator hose.
5. Remove overflow hose at radiator.
6. Remove A/C accumulator and move aside.
7. Remove transmission cooler line.
8. Remove fan wires from fan and shroud.
9. Remove fan to gain access to lower cooler line.
10. Remove transmission cooler line at fitting.
11. Remove upper shroud bolts.
12. Remove upper shroud.
13. Remove radiator.

Installation

1. Place radiator on lower support.
2. Install transmission lower cooler line.
3. Install upper shroud.
4. Install fan.
5. Install fan wires.
6. Install transmission upper cooler line.
7. Install upper and lower radiator hoses.
8. Install overflow hose.
9. Install A/C accumulator.
10. Fill cooling system.
11. Start engine and run with radiator cap removed until radiator upper hose becomes hot (thermostat open).
12. With engine idling, add coolant to radiator until level reaches bottom of filler neck.
13. Install filler cap.

FAN SHROUD

Removal (Upper)

1. Disconnect battery negative cable.
2. Drain cooling system.
3. Remove lower radiator hose at radiator.
4. Remove overflow tube at radiator.
5. Remove A/C accumulator and lay asied.
6. Remove transmission upper cooler line.
7. Remove upper fan bolts and disconnect wire from fan shroud.
8. Remove upper fan shroud.

Installation

For installation, reverse removal procedures. Fill cooling system as previously outlined.

Removel (Lower)

1. Remove radiator as previously outlined.
2. Remove A/C high pressure line at front bracket.
3. Remove A/C condenser and lay on top of inner panel.
4. Remove lower shroud.

Installation

For installation, reverse removal procedures. Fill cooling system as previously outlined.

ELECTRIC COOLANT FAN (FIGURE 6B-5)

CAUTION: Keep hands, tools and clothing away from engine cooling fan to help prevent personal injury. This fan is electrical and can come on whether or not the engine is running. The fan can start automatically in response to a heat sensor with the ignition in the "ON" position.

Removal

1. Disconnect battery negative cable.
2. Disconnect fan wires and fan at shroud.
3. Remove fan assembly.

Installation

Reverse removal procedures.

COOLANT RECOVERY BOTTLE (FIGURE 6B-6)

Removal

1. Disconnect battery negative cable.
2. Remove two bracket bolts and one fender bolt.
3. Remove coolant recovery bottle.

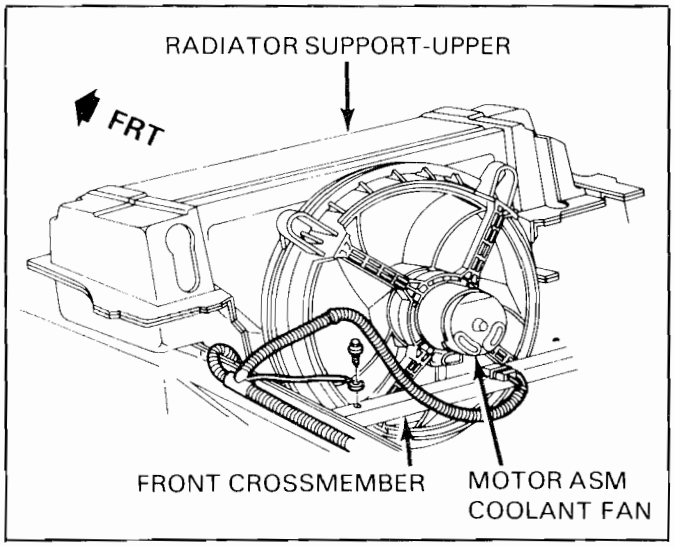


Figure 6B-5 Fan

Installation

Reverse removal procedures.

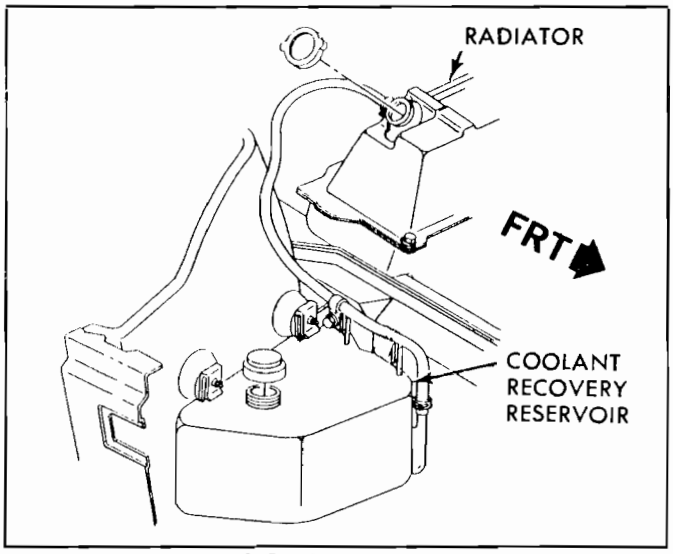


Figure 6B-6 Coolant Recovery Bottle

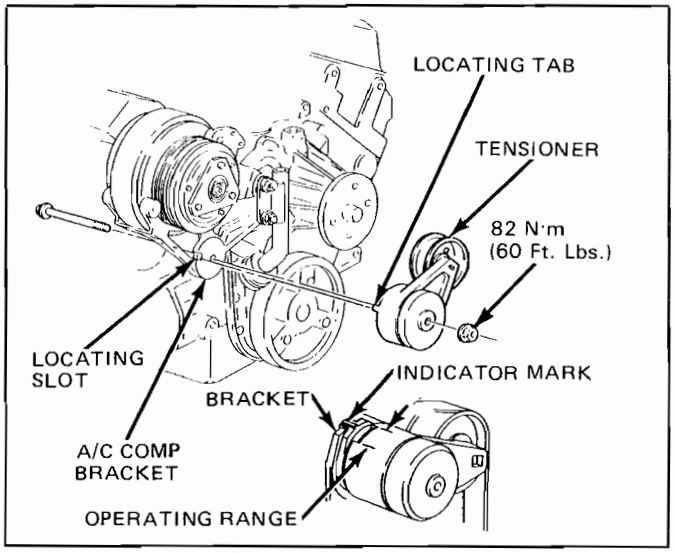


Figure 6B-7 Drive Belt Tensioner

DRIVE BELT (FIGURES 6B-7, 8)

NOTICE: Routine inspection of the belt may reveal cracks in the belt ribs. These cracks will not impair belt performance and therefore should not be considered a problem requiring belt replacement. However, the belt should be replaced if belt slip occurs or if sections of the belt ribs are missing.

A single (serpentine) belt is used to drive all engine accessories formerly driven by multiple drive belts. All belt driven accessories are ridgedly mounted with belt tension maintained by a spring loaded tensioner.

To remove or install the belt, push (rotate) the tensioner using a 1/2 inch breaker bar. Belt routing is shown in Figure 6B-8. To check belt tension, install belt tension gage BT-7825 or J-23600 between the alternator and A.I.R. pump. Belt tension should be 534-623 Newtons (120-140 lbs.)

The drive belt tensioner has the ability to control belt tension over a fairly broad range of belt lengths. However, there are limits to the tensioner's abiltiy to compensate for varying lengths of belts. With the tensioner outside of its operating range can result in poor tension control and/or damage to the tensioner. The tensioner has provisions for a visual check to verify that it is in the "operating range" (see Figure 6B-7).

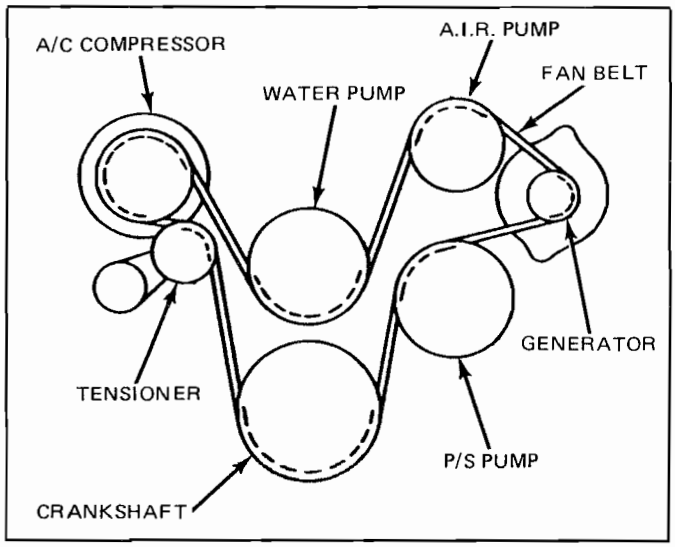


Figure 6B-8 Drive Belt Installation

ALUMINUM RADIATOR REPAIR

This radiator utilizes an aluminum core with plastic side tanks. The core and side tanks can be replaced separately and core repair is easily made with the hot melt adhesive method. A transaxle oil cooler is located in one of the side tanks, and on diesel application, an engine oil cooler is located in the opposite tank. The oil coolers can be replaced. The drain cock is located on the lower part of one of the tanks. The drain cock is also serviceable.

Core

The core is made of aluminum and is of the crossflow design. It utilizes large tubes that resist plugging, and repairs to the tubes and core are easily made using the hot melt adhesive method.

The core is attached to the tanks by clinched tabs on the core that can be bent back if tank or core replacement is required.

If the damage to a tube is too severe, a tube can be blocked or plugged as explained in "Tube Blocking. " No more than two tubes should ever be blocked on a core. Also replace the core if more than three tabs are broken on one side or if two adjacent tabs are broken.

Tanks

The tanks are attached to the core by the use of clinched tabs attached to the sides of the core. The clinched tabs can be bent back if the tanks need to be removed from the core. Bend the tabs back only enough to remove the tank. Overbending will weaken the tabs.

A high temperature rubber gasket is used to seal the mating surface between the core and the tank. (See Figure 6B-9. The gasket must be replaced any time a tank is removed from the core.

Transmission Oil Cooler

The transmission oil cooler is located to the left of the driver's side radiator tank. The oil cooler can be replaced by removing the tank from the core.

A leaking oil cooler gasket can be replaced without removing the tank from the core.

Drain Cock

The aluminum/plastic radiator utilizes a two piece plastic drain cock and a rubber seal. The drain cock is serviceable (See Figure 6B-10)

ALUMINUM RADIATOR SERVICE

The aluminum-plastic radiator can be repaired at the dealership. The following components are easily replaced:

- Core
- Tanks and gaskets
- Oil coolers and gaskets
- Drain cock and gasket

The **tanks cannot be repaired** if broken or cracked. The radiator core can be replaced and the new core used with the original tanks and oil cooler.

Precautions

As with all cooling system service, take measures to prevent personal injury and damage to the system.

CAUTION: To help avoid the danger of being burned, do not remove the radiator cap while the engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if the cap is taken off too soon.

NOTICE: DO NOT USE "BOIL OUT" TANKS OR VATS. Common service methods may actually destroy an aluminum radiator. Caustic or lye cleaning solutions must NOT be used for aluminum radiators.

- Do not open the hood if you can see or hear steam or coolant escaping from the engine compartment.
- Do not remove radiator cap if radiator feels warm.
- Do not remove the radiator cap or coolant recovery tank cap if the coolant in the recovery tank looks like it is boiling.
- Wear eye protection.
- Wear gloves to protect your hands against excessive heat or the effects of chemicals on your skin.
- Prevent dirt and water from entering the transmission oil cooler.
- Do not use boil-out tanks or vats or other tanks that have been used for copper and brass radiators. The flux, acid, and caustic cleaners remaining in these tanks will attack the aluminum and cause radiator failure. A separate test tank containing clean water is strongly recommended for servicing aluminum-plastic radiators.

NOTICE: Never use shop air to pressure test radiator that is not regulated at 20 psi (138 kPa). Pressures over 20 psi (138 kPa) will damage the radiator.

DIAGNOSIS

Leak Testing

Some core leaks can be detected by merely adding water to the radiator. It is helpful to clean the core so that the damaged area can be more easily found.

1. Remove dirt and insects from the fins with a common water hose without a nozzle. Excessive water pressure could damage the fins.

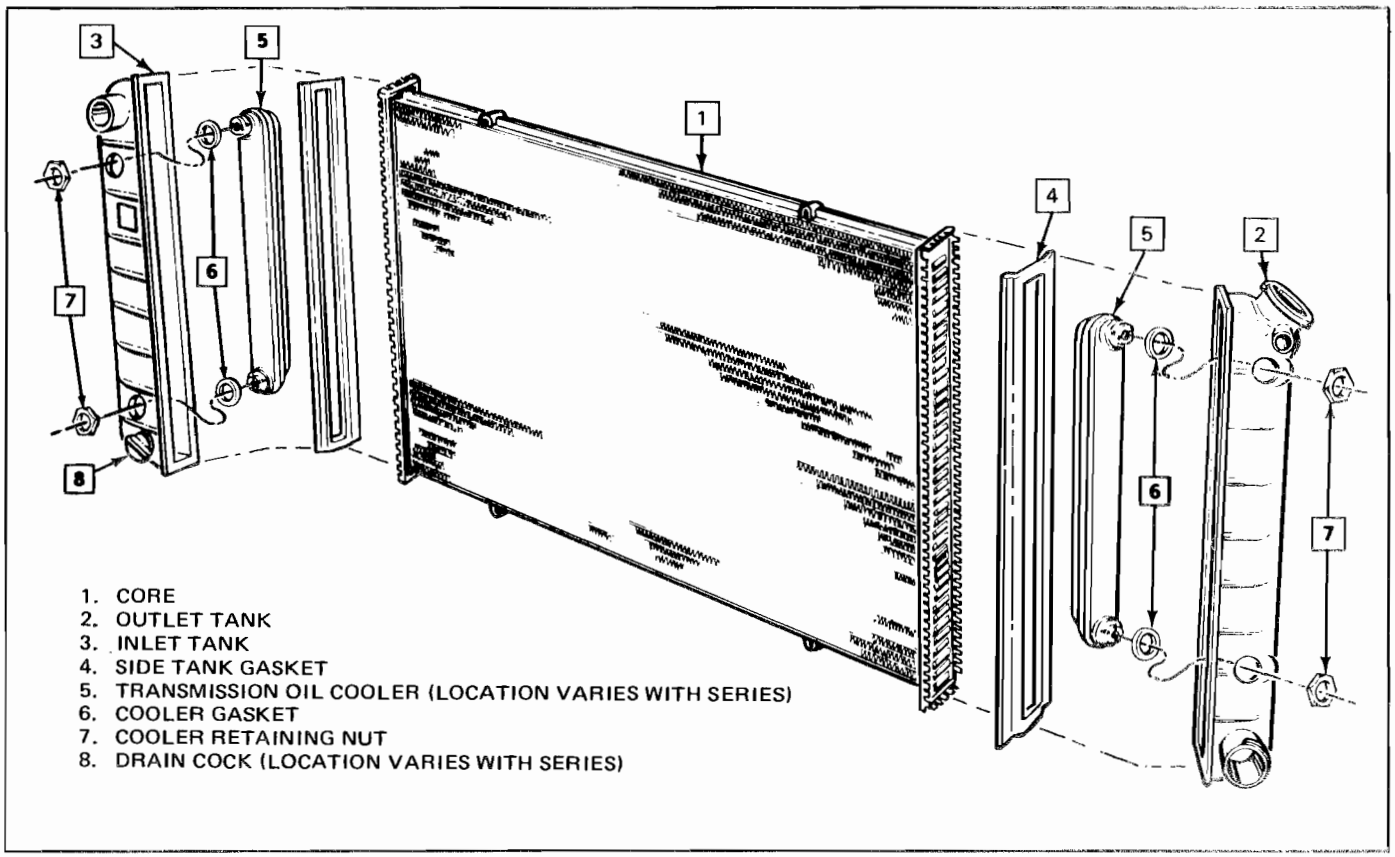


Figure 6B-9 Aluminum Radiator

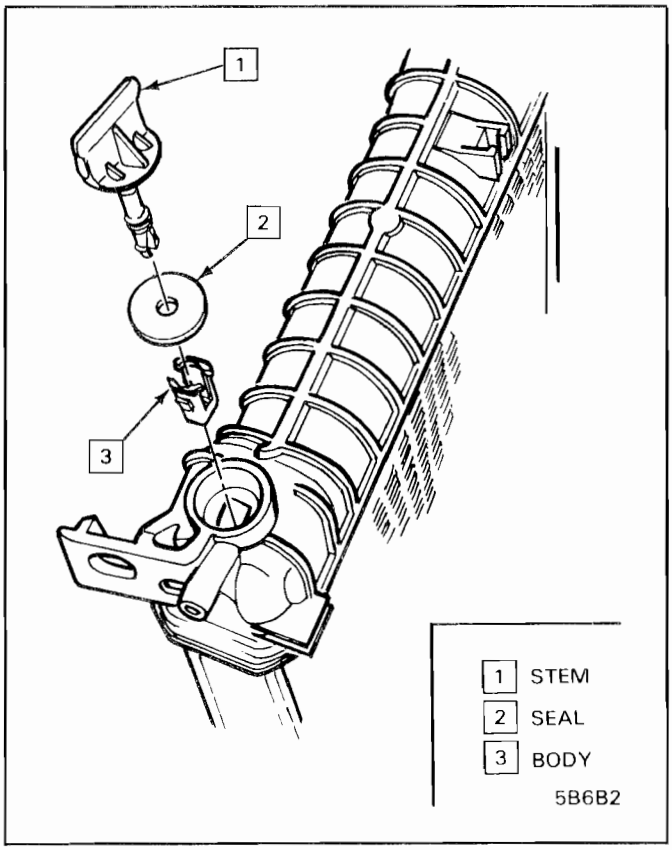


Figure 6B-10 Aluminum Radiator Drain Cock

2. Scrub the core with a soft-bristle brush using clean, hot water or hot water with a mild detergent solution.

On-Vehicle Pressure Testing

You can pressure-test the aluminum-plastic radiator with a common pump and gage, such as BT-7002-3 or J-24460-01 with J-23699 (Figure 6B-11). With the system at a cool temperature, remove the radiator cap, connect the gage, and apply normal system operating pressure. Do not exceed 20 psi (138 kPa). Watch the gage needle for an indication of a leak, and examine the radiator and other cooling system parts for signs of escaping coolant.

Repair all hose and hose connections as required. Also check radiator cap to ensure that it will maintain the correct pressure.

If the radiator is found to be leaking during the pressure test, mark the leak area so that it is easily found once the radiator has been removed from the vehicle.

Off-Vehicle Leak Testing

NOTICE: Do not use boil-out tanks or vats or other tanks that have been used for copper and brass radiators. The flux, acid, and caustic cleaners remaining in these tanks will attack the aluminum and cause radiator failure. A separate test tank containing clean water is strongly recommended for servicing aluminum-plastic radiator.

1. Install test fittings or rubber test caps in the inlet

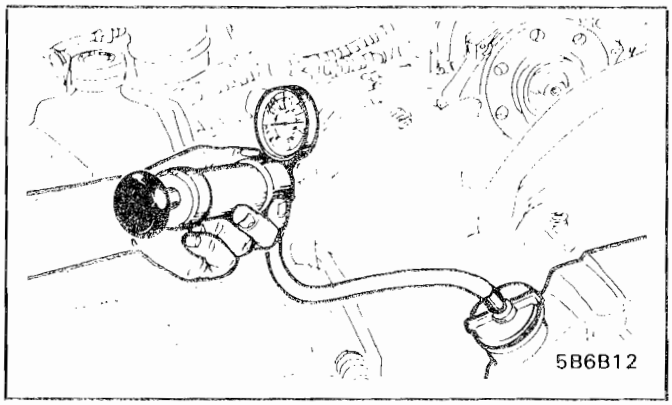


Figure 6B-11 Pressure Testing Radiator

and outlet necks and seal the oil cooler fittings with metal plugs to protect the cooler and keep the fluid from running out (Figure 6B-12).

2. Attach pressure tester and gradually apply air pressure until 20 psi (138 kPa) is attained. Do not exceed 20 psi (138 kPa). Check pressure gage to see if there is a pressure loss. To ensure that there are no small leaks, run water over the repair area and look for bubbles. (A mild detergent is very helpful).

   If a large water tank is available, the radiator can be submerged, and a check for air bubbles can be made.

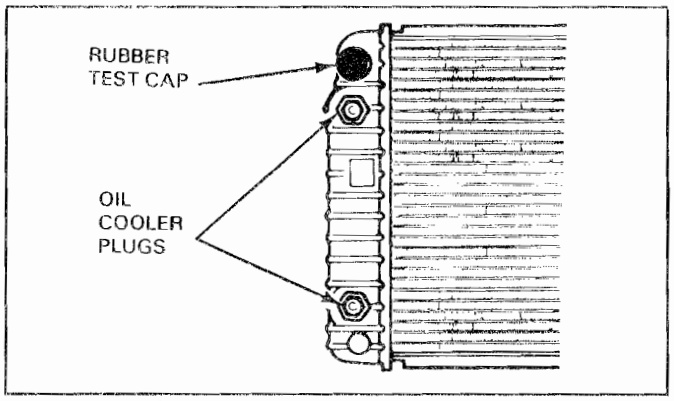


Figure 6B-12 Aluminum Radiator and Oil Cooler Plugs

Repairable Leaks

There are two types of leaks that can be repaired on the aluminum-plastic radiator: core leaks and gasket leaks. Leaks in the plastic tanks cannot be repaired.

Core leaks can occur in a tube or in the joints between the tubes and headers. Gasket leaks can occur in the joints between the plastic tanks and the headers or in the joints between the oil cooler fittings and the tank. Some leaks can be repaired while the radiator is on the car; however, it is usually best to remove the radiator.

Repair Methods

There are several methods that can be used to repair the radiator core, but the hot melt adhesive method has been found to be the most simple and effective.

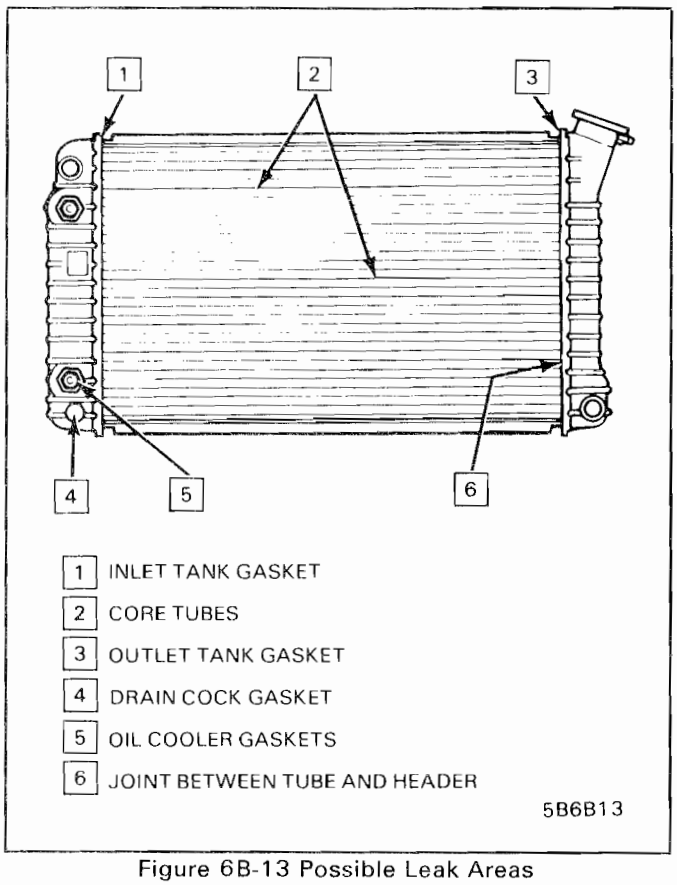


Figure 6B-13 Possible Leak Areas

The kit contains adhesive sticks, cotton swabs, wire brush and primer. The adhesive stick is reusable, has an indefinite shelf life, and is waste-free. The sticks must be stored in a sealed container to keep them dry (Figure 6B-14).

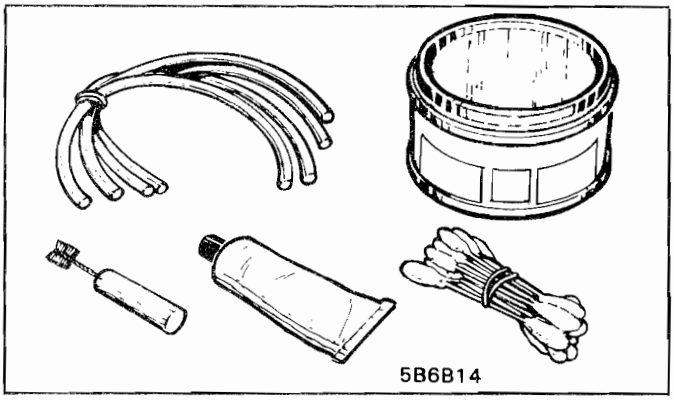


Figure 6B-14 Hot Melt Adhesive Repair Kit

Special Preparation

Cooling Fin Removal

For damaged areas that are between the cooling fins, it may be necessary to remove some of the fins. Do not remove more fins than necessary. Usually 6mm (1/4") beyond the leak or damage area is enough to make an effective repair. (Figure 6B-15).

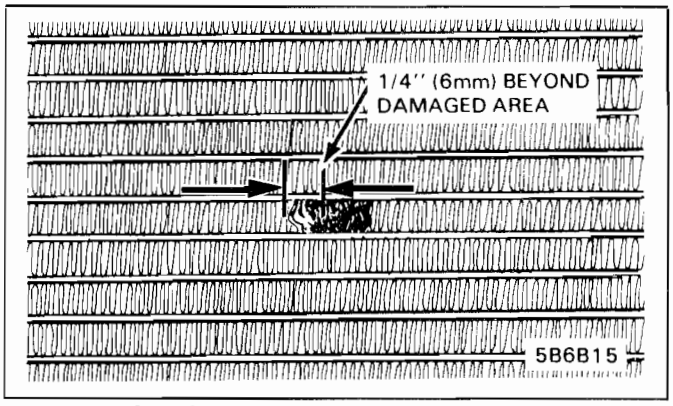


Figure 6B-15 Fins Removed from Damaged Area

Tube Blocking

If a tube is severely damaged, it can be blocked off. (Figure 6B-16).

NOTICE: DO NOT BLOCK OFF MORE THAN TWO TUBES IN A RADIATOR. BLOCKING OFF MORE THAN TWO TUBES WILL REDUCE THE COOLING CAPABILITY OF THE SYSTEM.

The tube should be cut off 6mm (1/4") from the header and pinched shut before it is cleaned and sealed. (See General Core Sealing).

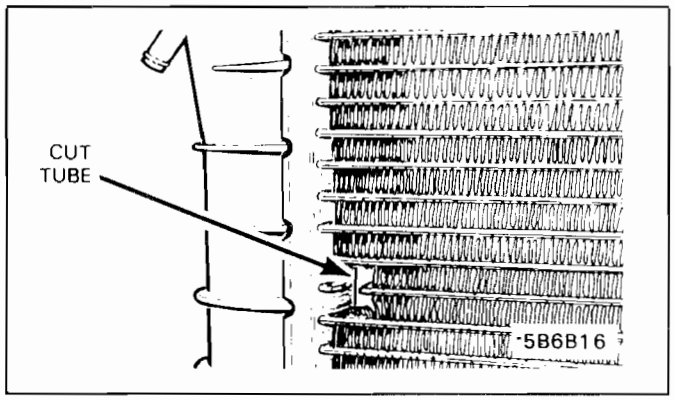


Figure 6B-16 Tube Blocking

Header Repair

If the header or a tube near the header requires a repair, the side tank does not have to be removed. A damp cloth can be placed against the side tank where the repair has to be made (Figure 6B-17). The side tank can also be submerged in a tank of water up to the header (Figure 6B-18).

NOTICE: One of these procedures have to be used when repairs are made on or near the header to prevent damage to the tank or gasket.

General Core Repair

Preparation of the surface in the repair area cannot be overemphasized. If the leak area surface is not clean, none of the repair materials will stick to the surface.

1. Position the core so the repair area is accessible.

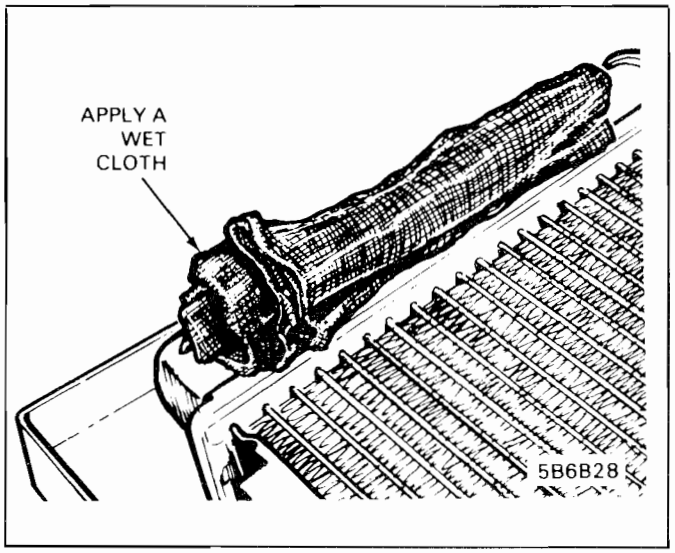


Figure 6B-17 Using Wet Cloth on Side Tank

2. Apply a wet cloth if you are working near the plastic tanks or the joints between the core tubes and header (Figure 6B-17); or submerge the tank in water (Figure 6B-18).

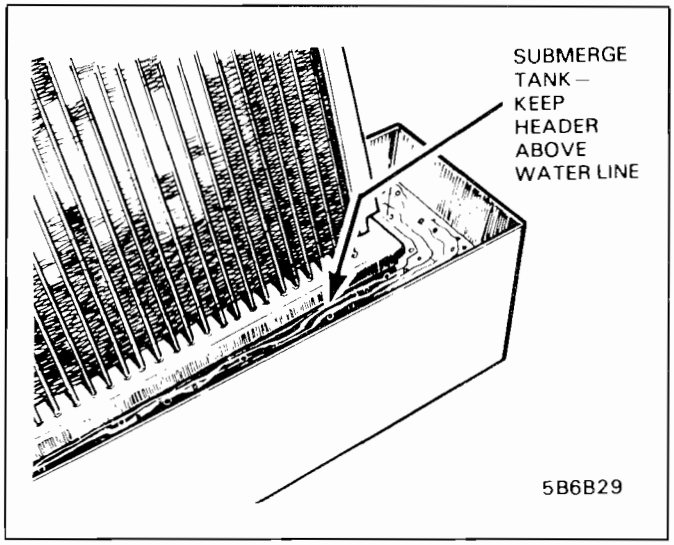


Figure 6B-18 Submerging Side Tank

3. Heat the repair area slightly with a small torch or heat gun to be sure it is dry. **Do not use a blow torch.**
4. Brush the area to be repaired with the small steel brush that is supplied in the kit and blow dust away from repair area. (See Figure 6B-19).
6. Open the tube of primer, using the spurred cap or a pin, and apply primer to the repair area only. Use of the primer produces a stronger repair. **Do not heat the primer.**

CAUTION: The primer contains trichlorethane.

- **It could be harmful or fatal if swallowed. If swallowed, get medical attention.**
- **Use with adequate ventilation.**

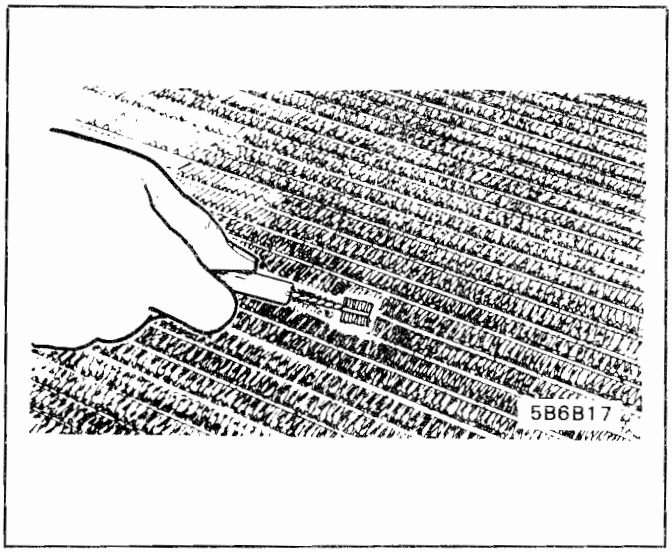


Figure 6B-19 Cleaning Area With Steel Brush

- **In case of eye contact, flush with plenty of water and get medical attention.**
- **In case of body contact, wash thoroughly with soap and water.**
- **Do not mix the primer with water.**

7. Scrub the repair area with a cotton swab until a fresh swab stays clean. The clear, yellow-brown coating does not have to be removed (Figure 6B-20).



Figure 6B-20 Scrubbing Area with Primer

8. Heat the repair area with the heat gun or by moving the torch in a circular pattern (Figure 6B-21). Use a soft, small blue flame (like a gas stove flame).
9. Withdraw the torch and rub the adhesive stick on the repair area (Figure 6B-22). The adhesive will flow at a temperature of approximately 500°F (260°C). If the stick doesn't start to melt, remove it and reapply the heat. **Do not heat the stick directly with a flame. High heat will burn and char the adhesive.**
10. Continue heating until the adhesive flows and wets the entire repair area and fills the joint. If a hole is in the center of a tube, heat the tube and let the hot surface melt and pull in the adhesive. The force of the flame or heat gun will also tend to guide the adhesive toward the hole. For leaks between a tube and header, flow the adhesive completely around the tube and header joint with the tank installed.

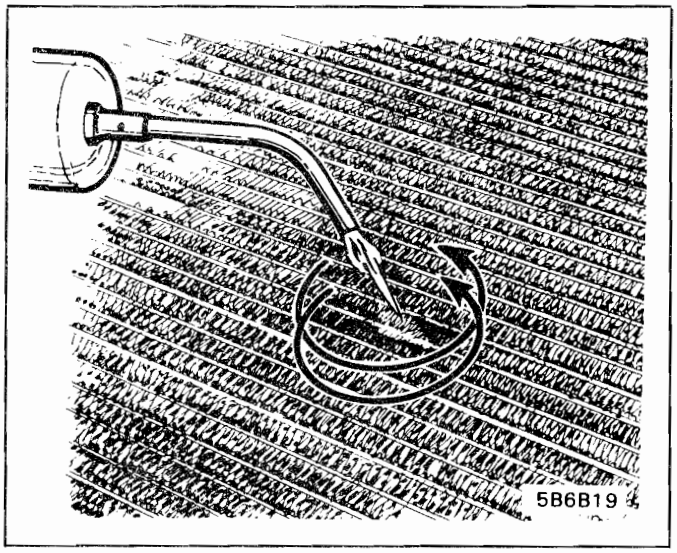


Figure 6B-21 Heating the Repair Area

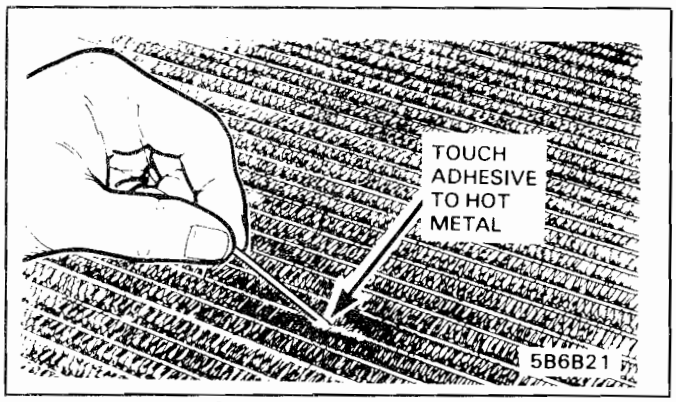


Figure 6B-22 Applying Hot Melt Adhesive

11. Heat the repair area until the adhesive is bubble-free and smooth, with a light yellow color. Curing is not required.
12. Test the radiator for leaks when cool. If the repair area still leaks, reheat it gently to dry it. Heat and reflow the adhesive or apply more as necessary to repair the leak.

Tank Gasket Leak Repair

Tank gasket leaks can easily be mistaken for tank or header leaks. If a plastic tank leaks from the header joint gasket, tighten the clinch tabs with or locking-type pliers (Figure 6B-23). If this method doesn't seal the leak, remove the tank for further inspection

1. Pry open the clinch tabs, except those under inlet, outlet, and filler necks, using J-33419-1 or a screwdriver (Figure 6B-24). Lift the tabs only enough to allow removal.

NOTICE: Care should be taken not to overbend tabs. Overbending could result in breakage. If there are more than 3 tabs broken on one side of

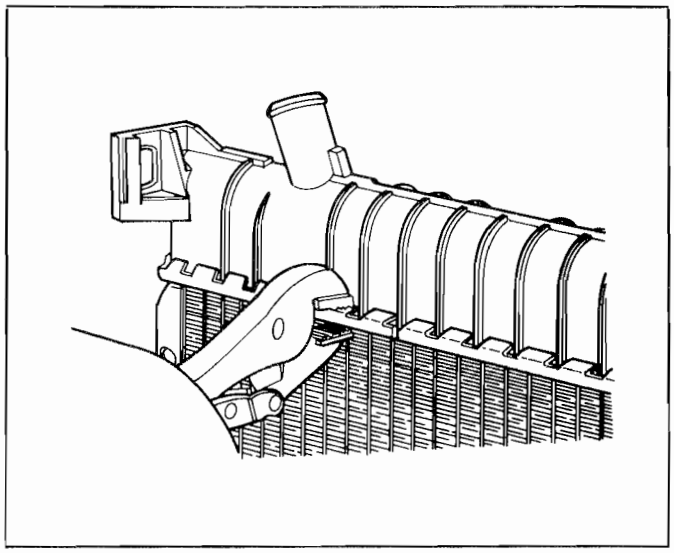


Figure 6B-23 Tightening Clinch Tabs

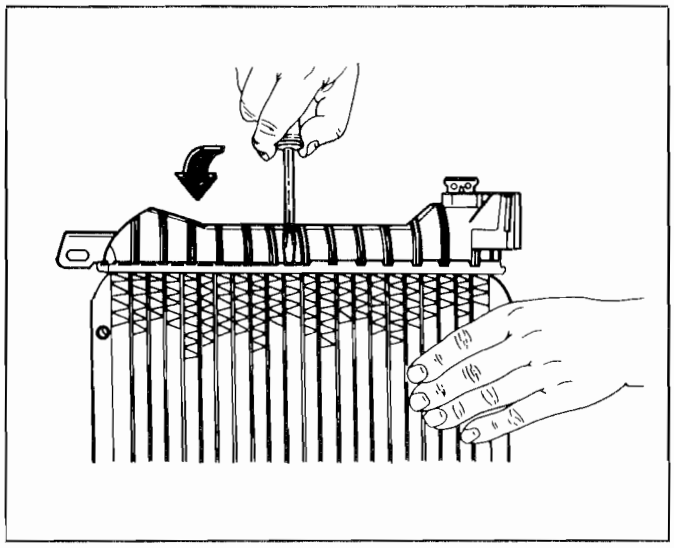


Figure 6B-24 Opening Clinch Tabs

the header, or more than 2 adjacent tabs together, the core must be replaced.

2. Lift the tank and slide it out from under the remaining clinched tab. You may have to tap the tank with your hand to dislodge the gasket. Lift the remaining tab(s) with pliers.
3. Remove and discard the gasket.
4. Clean the header and gasket groove of all dirt and old rubber.
5. Clean the sealing edge of the plastic tank.
6. Examine the header gasket surface and tank flange for evidence of leakage, and clean or repair the surface to remove dirt, burrs, and bumps.
7. Remove the oil cooler, if equipped, and install it in the new tank, if used.
8. Dip or coat the new tank gasket in engine coolant and position it on the header surface. The coolant helps hold the gasket in place.
9. Position the tank and gasket to the header, clamp it in place and secure it by bending four clinch tabs as shown in Figure 6B-25.

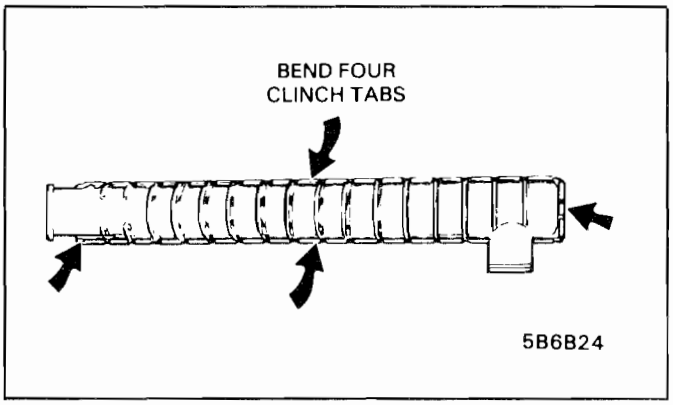


Figure 6B-25 Seating Tank to Core

10. Clamp remaining clinch tabs around the header using the clinching tool or pliers (Figure 6B-26).

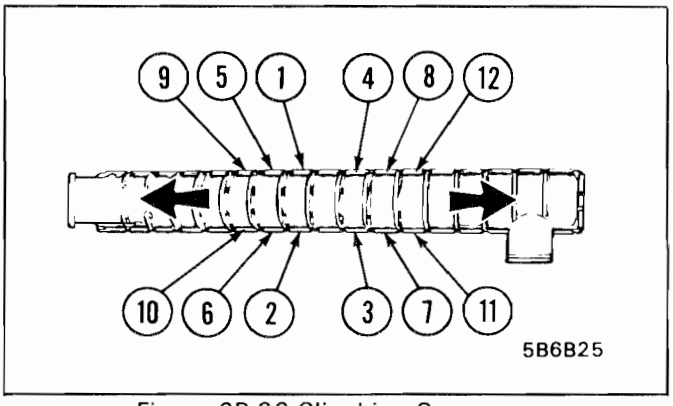


Figure 6B-26 Clinching Sequence

NOTICE: Tighten the clinch tabs as you would cylinder head bolts, starting at the center and working out to the ends.

11. Replace the core if there are more than three tabs broken on one side or two adjacent tabs broken.
12. Install the drain cock, if removed.
13. Test the radiator for leaks.

Oil Cooler Gasket Replacement

The outlet tank must be removed to replace the oil cooler, but the oil cooler gaskets can be replaced without removing the tank.

1. Remove the radiator and lay it on a flat surface.
2. Remove the bottom oil cooler nut and loosen the top nut.
3. Press the oil cooler into the hole and remove the gasket using a small hook (Figure 6B-27).
4. Flow-dry all surfaces on the tank and oil cooler.
5. Install a new gasket **without lubrication.** Be sure it is seated properly inside the tip of the fitting.
6. Reach into the oil cooler and push it into position against the tank.
7. Assemble the oil cooler nut loosely.
8. Replace the other gasket by following the same procedure.

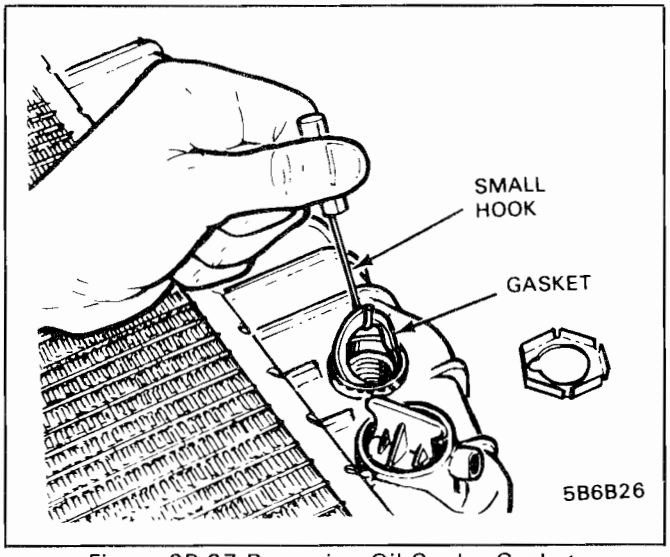


Figure 6B-27 Removing Oil Cooler Gasket

9. Install the oil cooler nuts and torque to 20 N·m (15 lbs. ft.). Do not overtighten, as damage to the gasket could result.
10. Leak-test the radiator.

Oil Cooler Replacement

1. Remove the outlet tank as previously outlined.
2. Remove nuts from the oil cooler fittings.
3. Remove oil cooler and gaskets from tank.
4. Remove old rubber gaskets, throw away, clean and dry seal areas.
5. Place rubber gaskets on a new oil cooler and place onto outlet tank fitting holes being careful not to loosen or misalign gaskets. Gaskets must be installed dry and free of dirt and oil.
6. Install and tighten nuts snugly onto fittings.
7. Torque nuts to 20 N·m (15 lbs. ft.). Overtorquing could cut the rubber gaskets.
8. Replace tank as previously described.
9. Test radiator.

Recore

If the radiator core is damaged beyond repair and the other parts are serviceable, install the original inlet and outlet tanks, oil cooler, radiator cap, and drain valve, along with the new core and new gaskets.

SECTION 6C

ENGINE FUEL

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All new General Motors vehicles are certified by the United States Environmental Protection Agency as conforming to the requirements of the regulations for the control of air pollution from new motor vehicles. This certification is contingent on certain adjustments being set to factory standards. In most cases, these adjustment points either have been permanently sealed and/or made inaccessible to prevent indiscriminate or routine adjustment in the field. For this reason, the factory procedure for temporarily removing plugs, caps, etc., for purposes of servicing the product must be strictly followed and, wherever practicable, returned to the original intent of the design.

For vehicles sold in Canada and equipped with non-closed loop engine, also refer to the appropriate Canadian Service Manual Supplement.

GENERAL

When working on the fuel system, there are several things to keep in mind.

- **Any time fuel system is being worked on, disconnect the negative battery cable except for those tests where battery voltage is required.**
- Always keep a dry chemical (Class B) fire extinguisher near the work area.
- Always use a backup wrench when loosening or tightening a screw couple fitting.
- The torque on a screw fitting is 30 N·m (22 ft. lbs.).
- The fuel pipes used on all PFI applications require the use of an "O" ring

  Replace all pipe with the same pipe and fittings that were removed.
- All fuel pipe must meet the GM Specification 124-M or its equivalent.
- All fuel hose must meet GM Specification 6163-M or its equivalent.
- Do not replace fuel pipe with fuel hose.
- Always relieve the line pressure before servicing any fuel system components.
- Do not do any repairs on the fuel system until you have read the copy and checked the pictures relating to that repair.
- Adhere to all Notices and Cautions.

All gasoline engines are designed to use only unleaded gasoline. Unleaded gasoline must be used for proper emission control system operation. Its use will also minimize spark plug fouling and extend engine oil life. Using leaded gasoline can damage the emission control system and could result in loss of emission warranty coverage.

All cars are equipped with an Evaporative Emission System. The purpose of the system is to minimize the escape of fuel vapors to the atmosphere. Information on this system will be found in Section 6E3.

FUEL METERING

Fuel Metering is accomplished through Port Fuel Injection.

Port Fuel Injection

The ECM is in complete control of this fuel delivery system during normal driving conditions.

The intake manifold function, like that of a diesel, is used only to let air into the engine. The fuel is injected by separate injectors that are mounted over the intake valve.

The ECM monitors all the vehicle functions as in the carbureted or TBI system. In addition to the normal sensors and inputs, this system utilizes a mass air flow sensor and a manifold air temperature sensor.

The mass air flow sensor measures the mass of air that goes through the intake manifold. It compensates for both temperature and barometric pressure variations and is mounted between the air cleaner and throttle body. (See Figure 6C-2.)

With the Port Injection System, there is no need for a Thermac, EFE, Map Sensor or Baro Sensor.

This system provides better cold driveability, less exhaust emissions as well as a better throttle response.

The Port Fuel Injection system utilizes an injection system where the injectors turn on at every crankshaft revolution (simultaneous double fire). The ECM controls the injector on time so that the correct amount of fuel is metered depending on driving conditions.

Two interchangeable"0"rings are used on the injector that must be inspected when the injectors are removed. Check "0"rings for cuts or other type of damage and replace as necessary.

The air cleaner is remotely mounted (See Figure 6C-1.). It is connected to the intake manifold by flexible air intake ducting.

Also, mounted between the air cleaner and intake, are the mass airflow sensor and throttle body.

The intake manifold is of a totally new design as it is only used to pass air. It is tuned and offers approximately an 8-10% vehicle performance improvement.

The throttle body design is very simple as it handles only air. It also utilizes an integral Idle Air Control to govern idle speed and a Throttle Position Sensor (TPS). The IAC and TPS are both described in Section 6E3. Engine coolant is pumped through the throttle body to prevent throttle icing.

The fuel rail is attached to the top of the intake manifold and supplies fuel to all the injectors.

A fuel pressure tap is located on the rail for quick pressure checks.

Fuel is recirculated through the rail continually while the engine is running. This removes air and vapors from the fuel as well as keeping the fuel cool during hot weather operation.

The fuel pressure regulator that is mounted on the fuel rail maintains a pressure differential across the injectors under all operating conditions. It is accomplished by controlling the amount of fuel that is

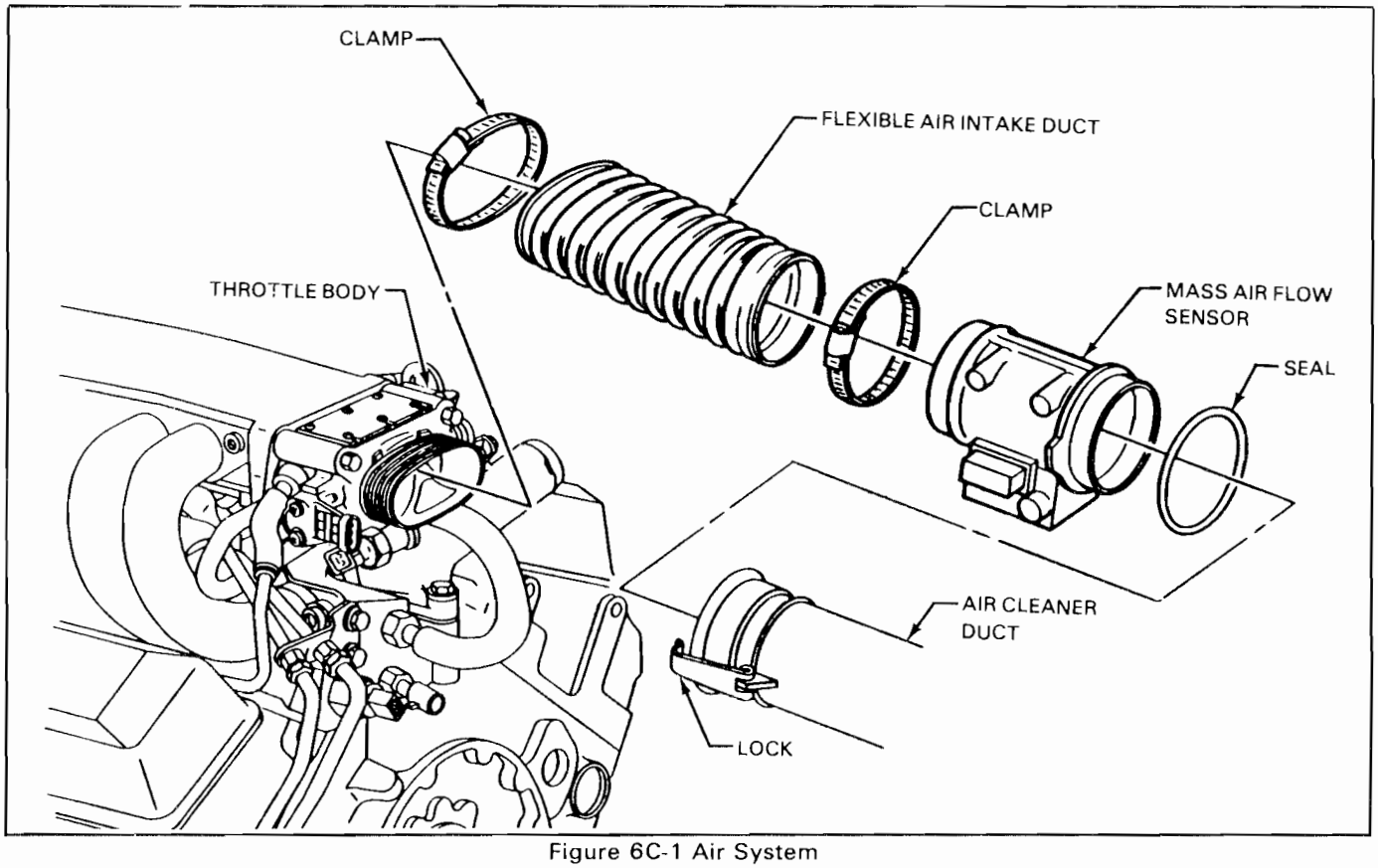


Figure 6C-1 Air System

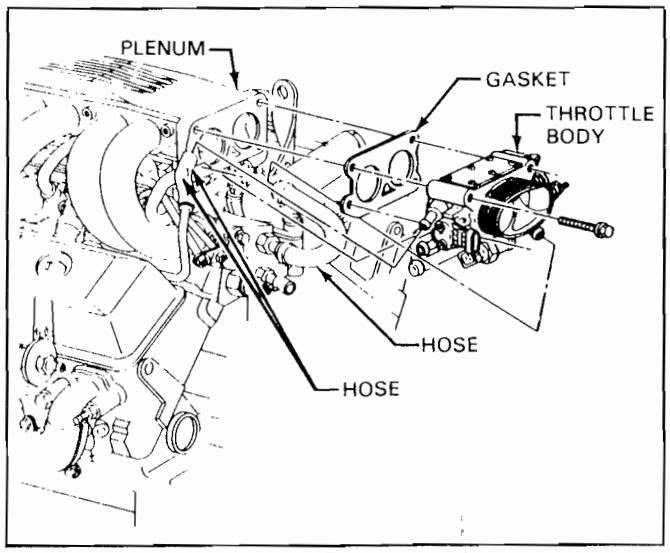


Figure 6C-2 Throttle Body

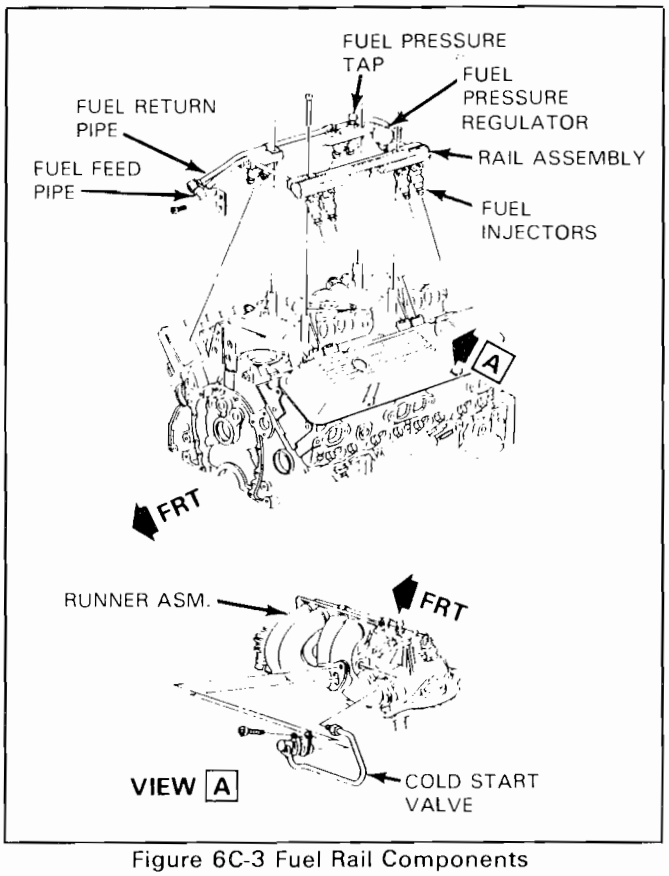


Figure 6C-3 Fuel Rail Components

recirculated back to the fuel tank based on engine demand.

See Section 6E3 for more information and diagnosis.

FUEL SYSTEM PRESSURE RELIEF

All PFI Engines

CAUTION: To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing fuel system components. To do this, see Section 6E3 Fuel Control System-On Car Service.

Unless this procedure is followed before servicing fuel lines or connections, fuel spray could occur.

When repair to the fuel system has been completed, start engine and check all connections that were loosened for possible leaks.

Refer to Section 6 for additional diagnosis of engine fuel system.

FUEL FILTERS

Fuel filters fall into two categories: in line filters and sending unit filter socks.

Inline Filters

CAUTION: To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing fuel system components. (See Fuel System Pressure Relief.)

Inline Filter can be found in the fuel feed line attached to the right frame rail. See Figure 6C-4.

Always use a backup wrench any time that the fuel filter is removed or installed. Also make sure that a good "O" Ring is used at all screw couple locations. Torque on fittings is 30 N·m (22 ft. lbs.).

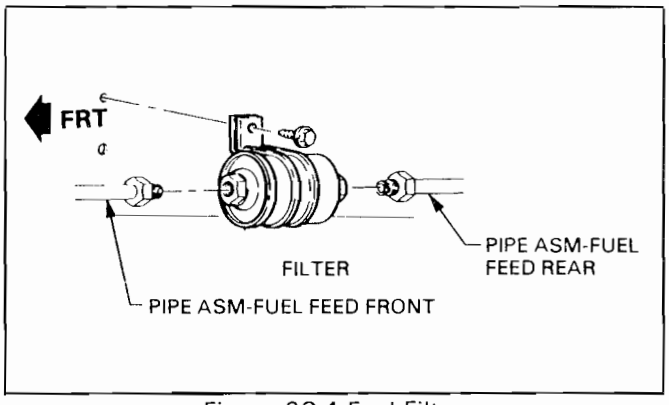


Figure 6C-4 Fuel Filter

In Tank Fuel Filters

A woven plastic filter is located on the lower end of the fuel pickup tube in the fuel tank. This filter prevents dirt from entering the fuel line and also stops water unless the filter becomes completely submerged in water. This filter is self-cleaning and normally requires no maintenance. Fuel stoppage at this point indicates that the fuel tank contains an abnormal amount of sediment or water; the tank should therefore be thoroughly cleaned.

The L98 has the electric pump attached to the fuel sending unit.

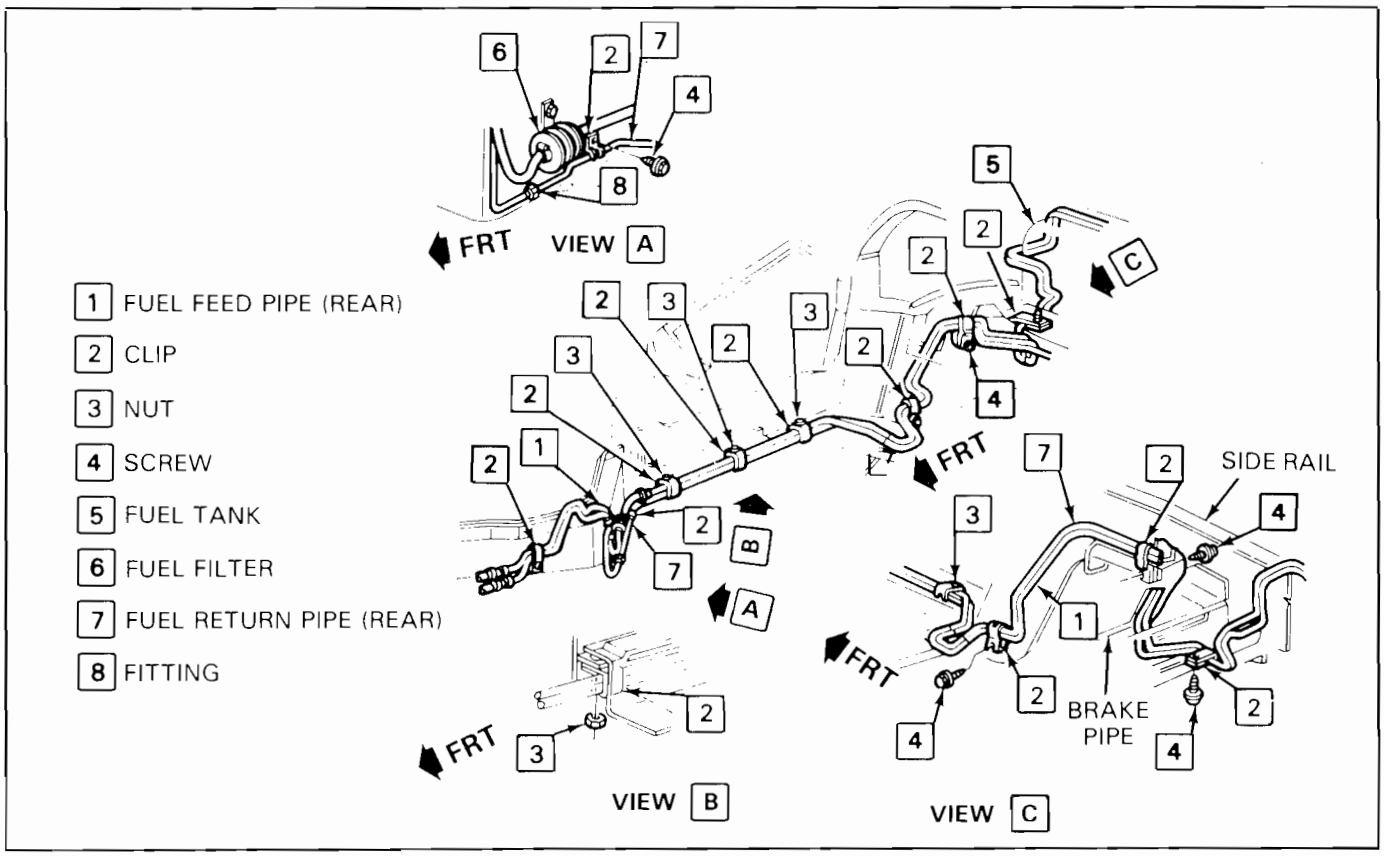


Figure 6C-5 Fuel Filter and Lines

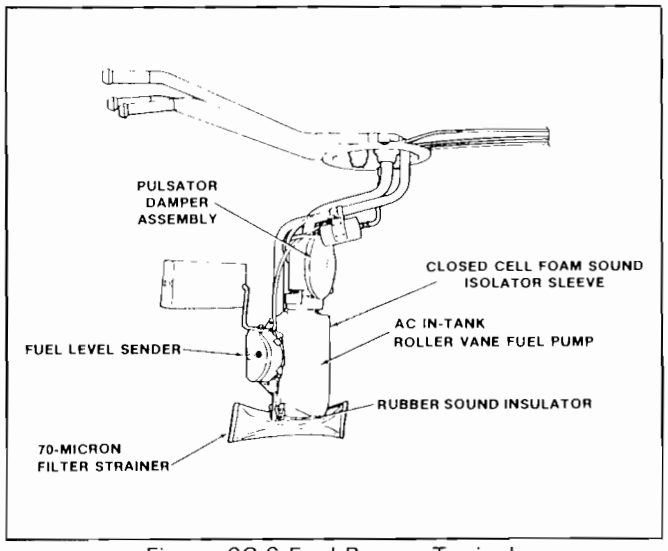


Figure 6C-6 Fuel Pump - Typical

FUEL PUMP

Electric Fuel Pump

The electric fuel pump used on gasoline engines is attached to the fuel sending unit.

The fuel pumps used on all PFI engines are higher pressure pumps. Information on pressure and fuel pump testing is covered in Section 6E3 Fuel Control System-On Car Service.

Inspection

If the fuel system is suspected of delivering an improper amount of fuel, it should be inspected and tested in the vehicle, as follows:

1. Make certain that there is fuel in the tank.
2. With the engine running, inspect for leaks at all fuel feed pipe and hose connections from fuel tank to injection rail. Tighten any loose connections. Inspect all hoses for flattening or kinks which would restrict the flow of fuel.

Fuel Pump Flow Test

1. On vehicles equipped with PFI, disconnect fuel feed line and connect a hose from the feed line to a suitable unbreakable container. Apply battery voltage to the fuel pump test terminal (terminal "G" of ALCL).
2. Fuel pump should supply 1/2 pint or more in 15 seconds.
3. If flow is below minimum, check for fuel restriction. If there is no restriction, check pump pressure.

Fuel System Pressure Test

See Section 6E3 Fuel Control System-On Car Service.

Electric Fuel Pump

Removal

1. Relieve fuel system pressure (See Fuel System Pressure Relief).

2. Disconnect negative battery cable.
3. Remove fuel filler door.
4. Remove fuel cap.
5. Remove fuel tank filler neck housing and disconnect drain hose.
6. Remove screws attaching fuel meter/fuel pump to tank
7. Disconnect fuel lines, fuel vapor line and electrical connector.
8. Remove fuel meter/fuel pump and gasket.
9. Pull fuel pump up into pulsator while pulling outward away from bottom support. Take care to prevent damage to rubber insulator and strainer during removal. After pump assembly is clear of bottom support, pull pump assembly out of pulsator for removal.

Installation

1. Inspect fuel pump pulsator for any signs of deterioration. Repalce as necessary. Also check rubber sound insulator at bottom of pump; replace if required.
2. Push fuel pump assembly into pulsator.
3. Install fuel lever sending unit and pump assembly into tank assembly. Use new gasket during reassembly.

NOTICE: Care should be taken not to fold over or twist the strainer when installing the sending unit as this will restric fuel flow.

4. Install attaching screws. Connect fuel lines, fuel vapor line and electrical connector.
5. Install fuel tank filler neck housing and drain hose.
6. Install fuel filler door and fuel cap.

Fuel Pump Relay

To control fuel pump operation, a fuel pump relay is used.

When the ignition switch is turned to "RUN" position, the fuel pump relay activates the electric fuel pump for 1.5 to 2.0 seconds to prime the injectors. If the ECM does not receive reference pulses from the distributor after this time, the ECM signals the relay to turn off the fuel pump. The relay will once again activate the fuel pump when the ECM receives distributor reference pulses. Refer to Figure 6C-7. Also see the electrical section of the manual for description, and operation.

FUEL TANK

The fuel tank is located in the rear of the vehicle

The tank is held in place by two metal straps, that are attached to the underbody. The fuel tank consists of a tough, pliable polyethylene liner inside a steel container.

The fuel tank, cap and lines should be inspected for road damage, which could cause leakage. Inspect fuel cap for correct sealing and indications of physical damage. Replace any damaged or malfunctioning parts.

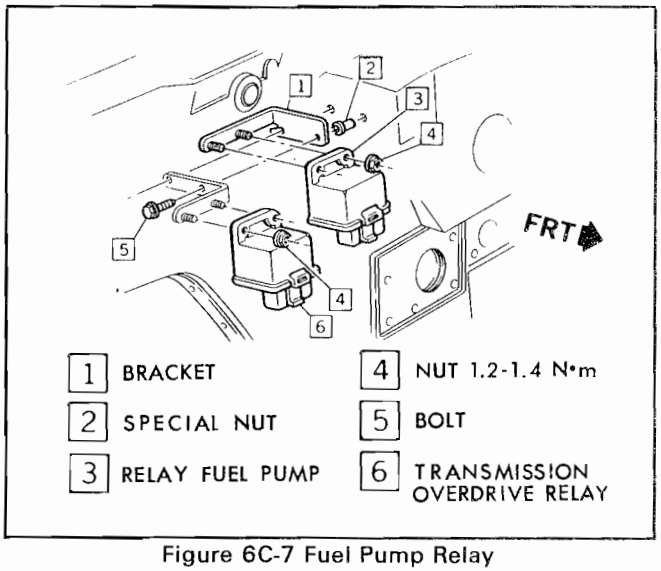


Figure 6C-7 Fuel Pump Relay

Before attempting service of any type on the fuel tank, always (1) remove negative battery cable from battery, (2) place "no smoking" signs near work areas, (3) be sure to have CO2 fire extinguisher hand, (4) wear safety glasses and (5) siphon or pump fuel into an explosive proof container.

Fuel Tank Filler Neck

To help prevent refueling with leaded gasoline, the fuel filler neck on gasoline engine cars has a built-in restrictor and deflector. The opening in the restrictor will only admit the smaller unleaded gas nozzle spout, which must be fully inserted to bypass the deflector. Attempted refueling with a leaded gas nozzle or failure to fully insert the unleaded gas nozzle will result in gasoline splashing back out of the filler neck.

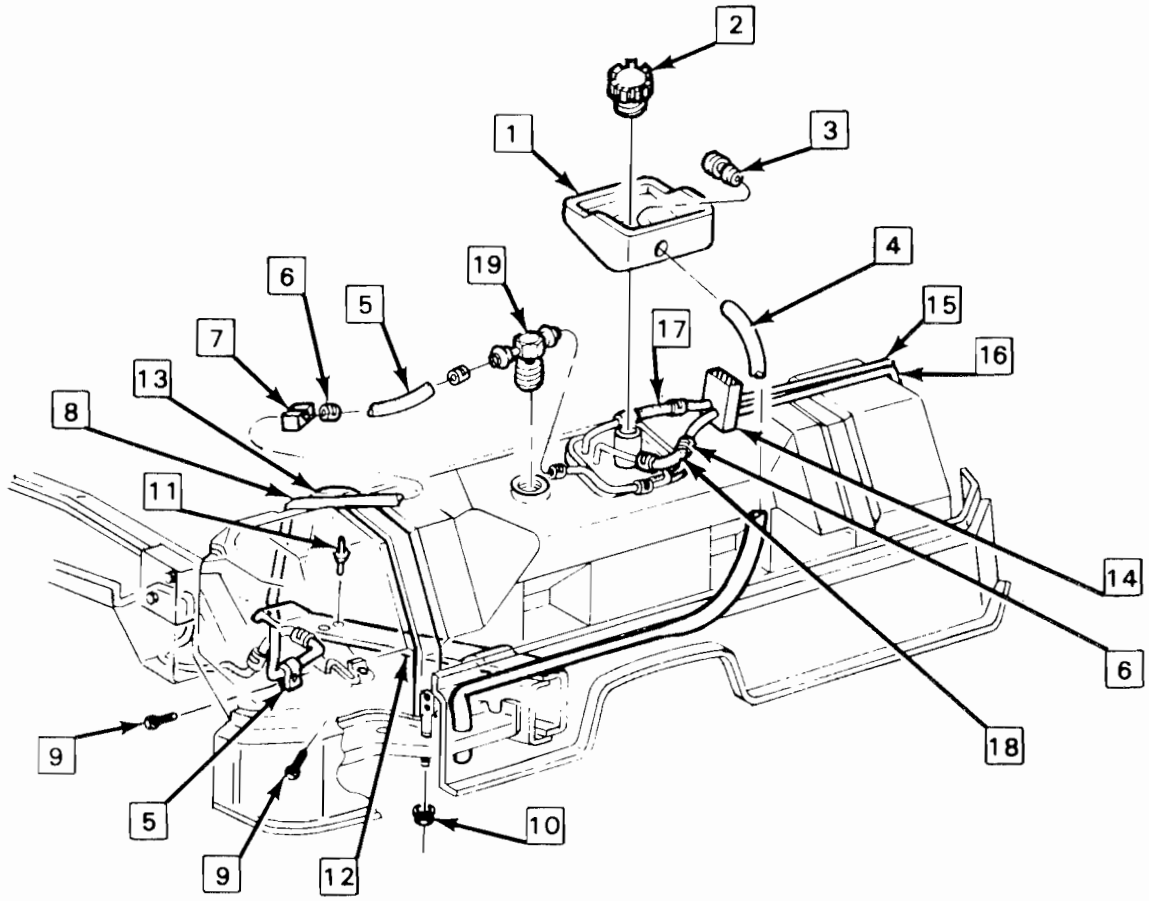
Draining Fuel Tank

1. Disconnect the negative battery cable. Also have a dry chemical (Class B) fire extinguisher near the work area.
2. Use a hand operated pump device when possible to drain as much fuel through the filler tube as possible.
3. If a hand operated pump device cannot be used to complete the draining process, use a siphon at the main (not return) fuel pipe at the fuel tank gage unit.

   CAUTION: Never drain or store gasoline or diesel fuel in an open container due to the possibility of fire or explosion.
4. Reinstall any removed hoses, lines and cap.

Fuel Tank Replacement

1. Remove battery ground cable.
2. Drain fuel tank.
3. Remove fuel tank filler door.
4. Remove fuel tank filler neck housing and drain hose.



1	FILLER NECK HOUSING	11	RIVET
2	FUEL CAP	12	SUPPORT
3	NIPPLE	13	STRAP
4	DRAIN HOSE	14	RETAINER
5	VAPOR HOSE	15	FUEL FEED PIPE
6	CLAMP	16	FUEL RETURN PIPE
7	RETAINER	17	FUEL FEED HOSE
8	VAPOR PIPE	18	FUEL RETURN HOSE
9	BOLT	19	FUEL VAPOR CONNECTOR
10	NUT		

Figure 6C-8 Fuel Tank

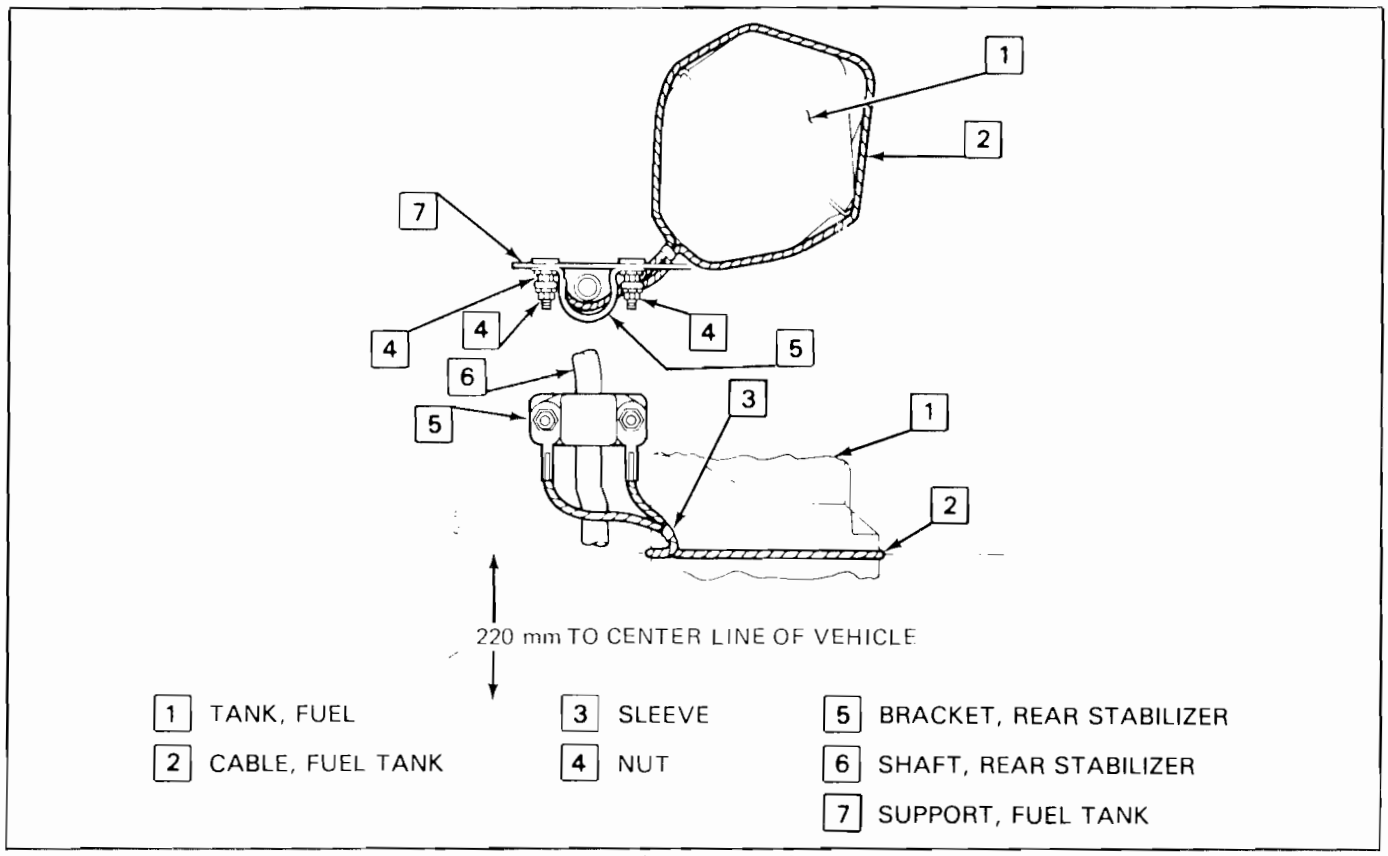


Figure 6C-9 Fuel Tank Cables

5. Disconnect fuel feed hose, fuel return hose, vapor hose and electrical connector from fuel meter and pump assembly.
6. Remove license plate to gain access for fascia to impact bar bolts.
7. Remove 2 carriage bolts securing fascia to impact bar.
8. Raise vehicle on hoist.
9. Remove spare tire and tire carrier.
10. Disconnect oxygen sensor electrical connector.
11. Remove exhaust system as a complete unit by disconnecting from front crossover pipe at exhaust manifold. Refer to Section 6F.
12. Remove both inner fender braces.
13. Remove both rear inner fender panels.
14. Disconnect antenna ground strap.
15. Remove bolt securing fuel vapor pipe to left hand fuel tank strap.
16. Disconnect fuel tank cables from rear right and left hand stabilizer shaft brackets.
17. Remove all rear lamps (side marker, tail, backup, license plate and spare tire.).
18. Remove 4 screws securing bottom edge of fascia to energy absorber pad.
19. Remove 3 nuts securing each side of fascia to horizontal body retainer. Refer to Rear Bumper Removal in Section 2B.
20. Remove nuts from right and left vertical retainer securing fascia to body. Refer to Rear Bumper Removal in Section 2B.
21. Remove 4 frame extension bolts (2 each side).
22. Loosen, but do not remove 4 remaining frame extension bolts.
23. With the aid of an assistant, remove remaining frame extension bolts and pull fuel tank and frame assembly rearward pushing cover outward. Tilt assembly down to remove and clear cover.
24. Remove tank straps and remove tank. If fuel tank is being replaced, transfer cables, fuel meter and pump, and fuel connector to new tank.

Installation

1. Position tank on frame extension and secure to tank supports with straps.
2. With the aid of an assistant, install tank and frame assembly in vehicle and secure with bolts.
3. Install nuts on right and left vertical retainers.
4. Install 3 nuts securing each side of fascia to horizontal body retainer.
5. Install screws securing bottom edge of fascia energy absorber pad.
6. Install all rear lamps and spare tire lamp.
7. Install fuel tank cable to stabilizer shaft brackets.
8. Install bolt securing fuel vapor pipe to left hand fuel tank strap.
9. Connect antenna ground strap.
10. Install both rear inner fender panels.
11. Install both inner fender braces.
12. Install exhaust system.
13. Connect oxygen sensor electrical connector.
14. Install spare tire and carrier.
15. Lower vehicle.

16. Install bolts securing fascia to impact bar.
17. Install license plate.
18. Connect fuel feed hose, fuel return hoses, vapor hose and fuel meter electrical connector.
19. Install fuel tank filler neck housing and drain hose.
20. Install fuel tank filler door.
21. Connect battery ground cable.
22. Add fuel to tank.

Fuel Tank Cables

Replacement

If replacement of fuel tank cables becomes necessary, the following procedure should be used.

1. Prior to assembly of fuel tank on frame extension, assemble cables to fuel tank and cinch securely as shown in Figure 6C-9.
2. Crimp sleeve with crimping tool to maintain adequate load to prevent any side or radial movement.

Fuel System Cleaning

CAUTION: This procedure will NOT remove all fuel vapor. Do not attempt any repair on tank or filler neck where heat or flame is required, as an explosion resulting in personal injury could occur.

If trouble is due to contaminated fuel or foreign material that is in the tank, it can usually be cleaned. If tank is rusted internally, it should be replaced.

1. Disconnect negative battery cable.
2. Disconnect engine harness connector on HEI distributor Have dry chemical (Class B) fire extinguisher near the work area.
3. Relieve fuel system pressure (see "Fuel System Pressure Relief").
4. Drain fuel tank (see "Draining Fuel Tank").
5. Remove fuel tank (see "Fuel Tank Removal").
6. Remove external fuel filter and inspect for contamination. If filter is plugged, replace when noted in Step 16.
7. Locate tank away from heat, flame or other source of ignition. Remove fuel gage sending unit and pump assembly and inspect condition of strainer. If strainer is contaminated, a new strainer should be installed upon reassembly.
8. Complete draining of tank by rocking it and allowing fuel to run out of fuel meter/pump assembly opening.
9. Flush fuel tank with running hot water for at least five minutes. Pour water out of fuel sending unit opening. (Rock tank to be sure that removal of water is complete.)
10. Disconnect fuel feed pipe at fuel rail connector and use air pressure to clean fuel line. Apply air pressure in the opposite direction fuel normally flows through the line. Disconnect return line at fuel rail and apply air pressure to clean return line. Reconnect and torque all pipes to 30 N·m (22 lb. ft.).
11. Use low air pressure to clean pipes on fuel gage sending assembly unit.
12. Install new strainer on fuel meter sending unit pump assembly, if required. Install fuel gage sending unit and pump with new gasket into tank and install fuel tank. Connect fuel gage wire harness to body harness. Connect all fuel lines except feed line to external fuel filter.

    NOTICE: Care should be taken not to fold over or twist strainer when installing sending unit as this will restrict fuel flow.

13. Connect a hose to feed line to external fuel filter and insert other end of hose into a one gallon fuel can.
14. Connect battery cable.
15. Put six gallons of clean fuel into fuel tank and apply 12 volts to Terminal "G" of ALCL to operate fuel pump to pump two quarts of fuel into fuel can. This will purge fuel pump.
16. Remove hose and install fuel filter.
17. Check all connections for leaks; tighten all hose clamps.
18. Connect engine harness connector to HEI distributor.

Fuel Tank Purging Procedure

The following procedure is used prior to servicing fuel tank.

1. Remove fuel gage unit and drain all remaining fuel from tank.
2. Visually inspect interior cavity of tank. If any fuel is evident, drain again.
3. Move tank to flushing area (wash rack).
4. Fill tank completely with tap water, agitate vigorously and drain.
5. Add gasoline emulsfying agent to the tank, refill with water, agitate mixture for 10 minutes, drain tank completely.

   For correct gasoline emulsfying agent to water mixture, refer to the manufacturer's specifications. Use an available emulsfying agent, such as "Product-Sol No. 913" or equivlanet.
6. When empty, refill the overflowing with water. Completely flush out remaining mixture and empty tank.
7. If available, an explosion meters should be used to check for negative reading.
8. Perform required service work.

Fuel Tank Leak Test Procedure

Plug all outlets and before removing a fuel tank for a suspected fuel leak, make sure that it is not one of the fuel hoses that is leaking onto the tank.

On Car Test

If fuel is leaking from tank, replace tank.

Off Car

Apply a small amount of air pressure to tank through vent tube (approximately 7 to 10 kPa or 1 to 1-1/2 lbs. of pressure)

Test repaired area for leaks with soap solution or by submersion. If leak is noted, replace tank.

Fuel Gage Sending Unit

The fuel gage sending unit is attached to the top of the fuel tank. It is held in place with 9 screws and a gasket is used between the tank and sending unit.

The sending unit has three places to attach hoses. One line is for the fuel feed line. The second line is connected to the vapor canister, to keep fuel vapor from getting into the air (see Section 6E2). The third line is used as a fuel return line to the tank.

When a fuel gage sending unit is removed always make sure to install a new gasket. Figure 6C-6 shows the sending unit with electrical fuel pump.

Removal of Tank Unit

See Fuel Pump Removal

Fuel Filler Cap

the fuel tank filler neck is equipped with a screw-type cap. The threaded part of the cap requires several turns counterclockwise to remove. The long threaded area was designed to allow any remaining fuel tank pressure to escape while the cap was being removed. A built-in torque-limiting device prevents overtightening. To install, turn the cap clockwise until a clicking noise is heard. This signals that the correct torque has been reached and the cap is fully seated.

NOTICE: If a fuel filler cap requires replacement, use only a cap with the same features. Failure to use the correct cap can result in a serous malfunction of the system.

Fuel Feed and Return Pipe

NOTICE: Fuel and vapor hoses and pipes are specially manufactured. If replacement becomes necessary, it is important to use replacement hoses or pipe meeting GM Specifications. Hoses and pipes not meeting GM Specification could cause early failure or failure to meet emission standard.

When replacing fuel feed and return pipes, always replace them with welded steel tubing meeting GM Specification 124M or its equivalent. The replacement pipe must utilize the same type of fittings as the original pipes to ensure the integrity of the connection.

NOTICE: Do not replace fuel pipe with fuel hose or any other type of tubing such as copper or aluminum. Only tubing meeting the 124M specification is capable of meeting all the pressure and vibration characteristics necessary to ensure the durability standard required.

- Always check and replace any "O" rings and or washers that appear damaged.
- Fuel feed and return pipes are secured to the underbody with clamps and screw assemblies. The pipes should be inspected occasionally for leaks, kinks or dents.
- Follow the same routing as the original pipe.
- Pipes must be properly secured to the frame to prevent chafing. A minimum of .25 mm (1/4") clearance must be maintained around a pipe to prevent contact and chafing.

Fuel and Vapor Hoses

NOTICE: Fuel and vapor hoses are specially manufactured. If replacement becomes necessary, it is important to use only replacement hoses meeting GM Specification 6163-M. These hoses are identified with the words "Fluoroelastomer" on them. Hoses not so marked could cause earluy failure or fail to meet emission standards.

- Do not use rubber hose within 4" of any part of the exhaust system or within 10" of the catalytic converter.

PFI Fuel Pipes

Due to the fact that the fuel pipes are under high pressure, these systems require special consideration for service.

Many of the feed and return pipes use screw couplings with "O" Rings. Any time these fittings are loosened to service or replace components ensure that:

- A backup wrench is used to loosen and tighten the fitting.
- Check all "O" rings at these locations (if applicable) for cuts or any damage and replace any that appear worn or damaged.
- Use correct torque when tightening these fittings.
- If pipes are replaced always use original equipment parts, or parts that meet the GM specification for those parts.

ACCELERATOR CONTROLS

The accelerator control system is cable type. There are no linkage adjustments.

As there are no adjustments, the specific cable, for each application must be used. Only the specific replacement part will work.

When work has been performed on accelerator controls, always check to ensure that all components are installed as removed and that all linkage and cables are not rubbing or binding in any manner. Throttle should operate freely without bind between full closed and wide open throttle.

Accelerator Control Cable

Refer to Figure 6C-11 for removal and installation of accelerator control cable.

When performing service on the accelerator control cable, observe the following:

- Retainer must be installed with tangs secured over head of stud.

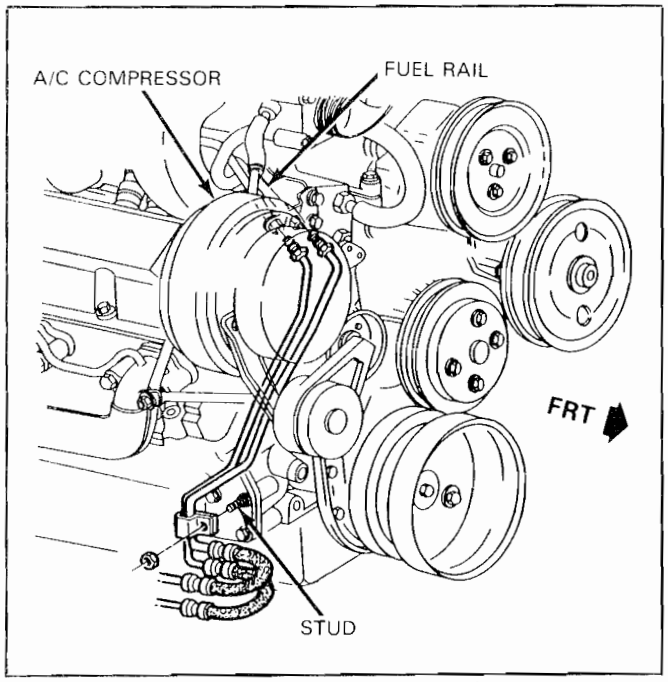


Figure 6C-10 Fuel Pipes and Hoses

- Conduit fitting at both ends of cable must have locking tangs expanded and locked in attaching holes.
- The braided portion of the accelerator cable assembly must not come in contact with the front of dash sealer during assembly, repair or replacement of the assembly.
- Flexible components (hoses, wires, conduits, etc.) must be routed within 50.0mm (2.0 in.) of moving parts of accelerator linkage outboard of support unless routing is positively controlled.

Whenever disconnecting or replacing parts, lube pivot points with Accelerator Linkage Lubricant, 1052541 or equivalent.

Accelerator Pedal

When performing service on the accelerator pedal, observe the following:

- The mounting surface between support and dash panel must be free of insulation. The carpet and padding in pedal and tunnel area must be positioned to lay flat and be free of wrinkles and bunches.
- Slip accelerator control cable through slot in rod and then install retainer in rod, being usre it is seated. Care must be utilized in pressing the retainer into hole in rod to assure the cable is not kinked or damaged in any way.
- After secured all components of the accelerator linkage, linkage must operate freely without binding between full closed throttle and full wide open throttle.

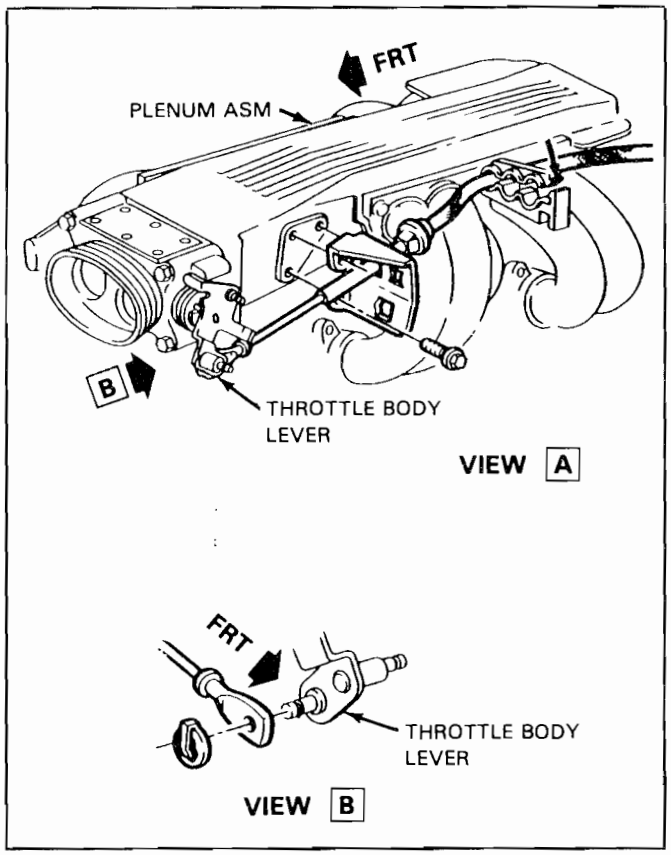


Figure 6C-11 Control Cable Attachment

- Wire, hoses, cables or other obstructions must not be placed within 13mm (33/64 in.) of cable or rod at any point in their travel.

Refer to Figure 6C-12 for replacement of accelerator linkage.

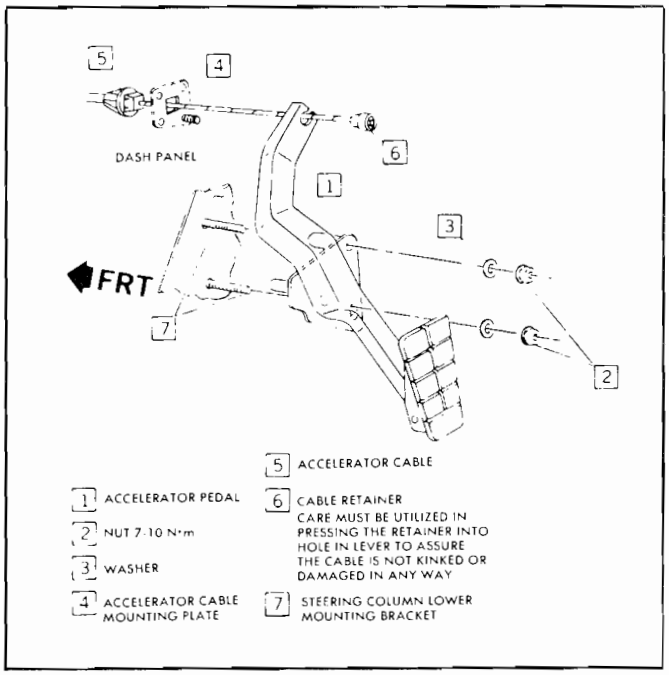


Figure 6C-12 Accelerator Pedal Assembly

SECTION 6D

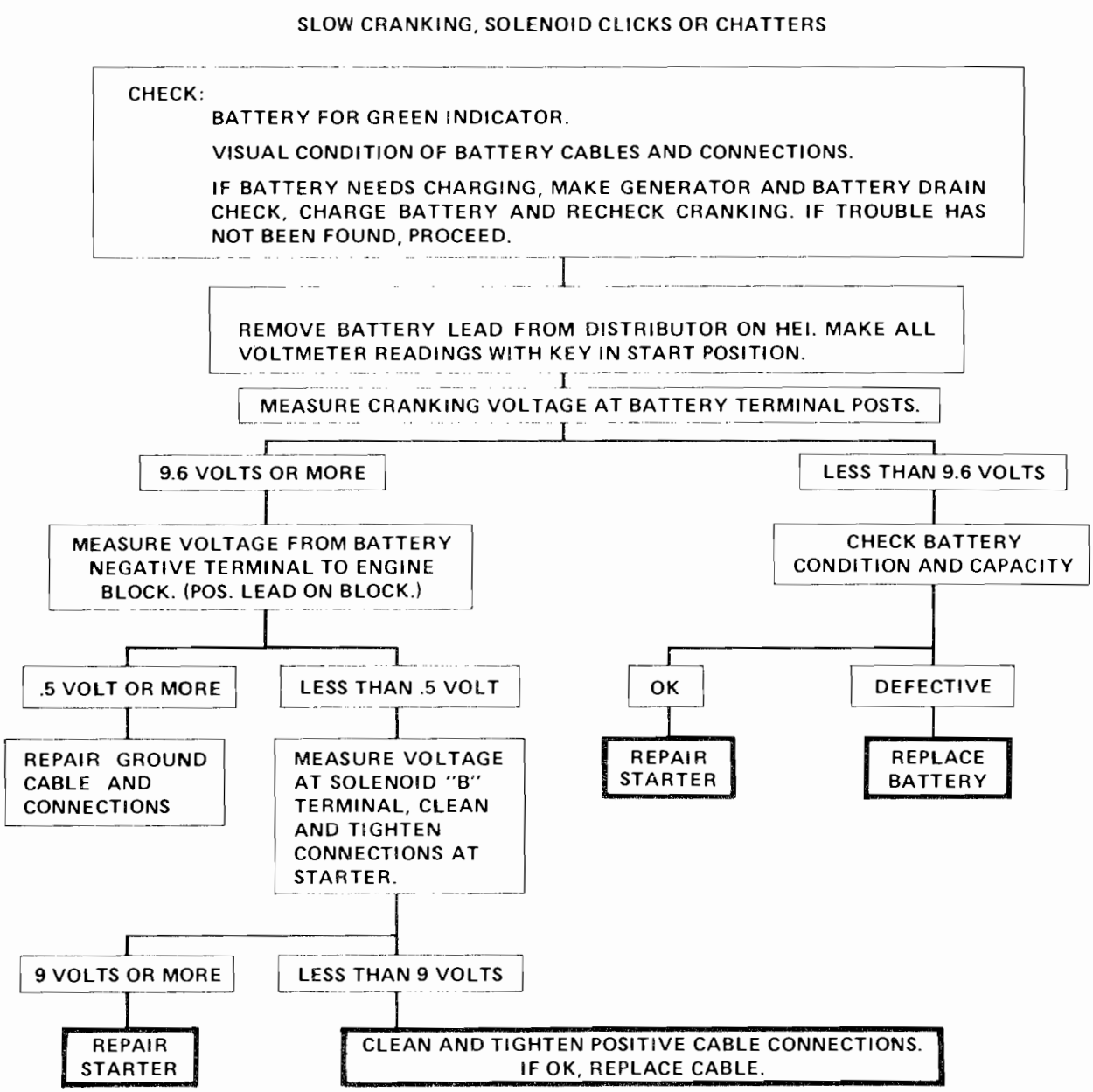
ENGINE ELECTRICAL-GENERAL

CONTENTS

ELECTRICAL SYSTEM GENERAL DIAGNOSIS 6D-1

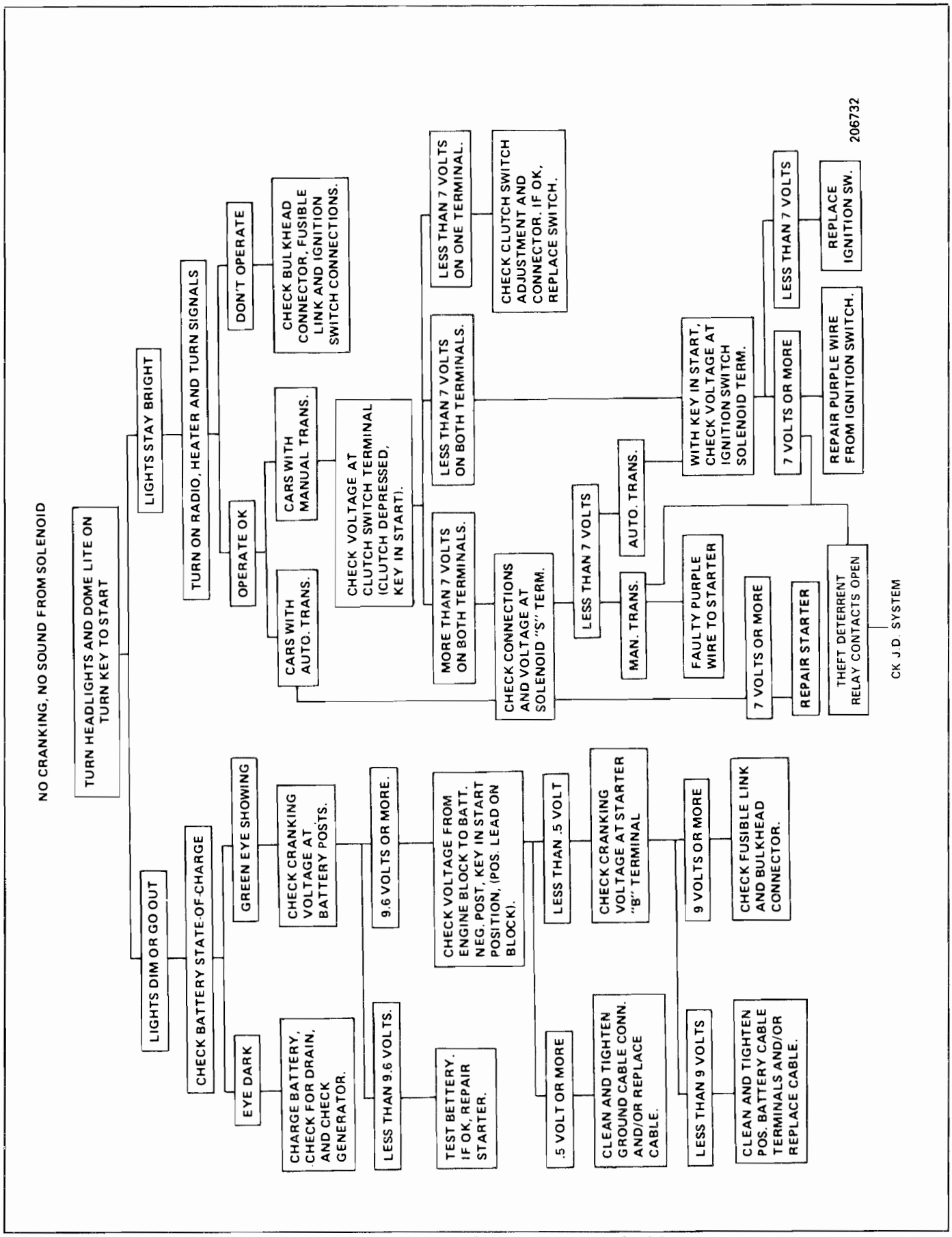
GENERAL ELECTRICAL SYSTEM DIAGNOSIS

Engine electrical system diagnosis includes the battery ignition (primary and secondary) starter (and related wiring) and the generator (and related wiring). The following diagnosis charts will aid in troubleshooting system faults. When a fault is traced to a particular component, refer to that component section of the service manual. Diagnosis of Engine Electrical Components covered in this section can be found in Section 8A, Electrical Diagnosis.



NOTE: THIS PROCEDURE IS DESIGNED FOR USE ON ENGINES AND BATTERIES AT ROOM OR NORMAL OPERATING TEMPERATURES. IT ALSO ASSUMES THERE ARE NO ENGINE DEFECTS WHICH WOULD CAUSE CRANKING PROBLEMS. TO USE IT UNDER OTHER CONDITIONS MIGHT RESULT IN MISDIAGNOSIS.

6D-1 General Electrical System Diagnosis 1 of 2



6D-2 General Electrical System Diagnosis 2 of 2

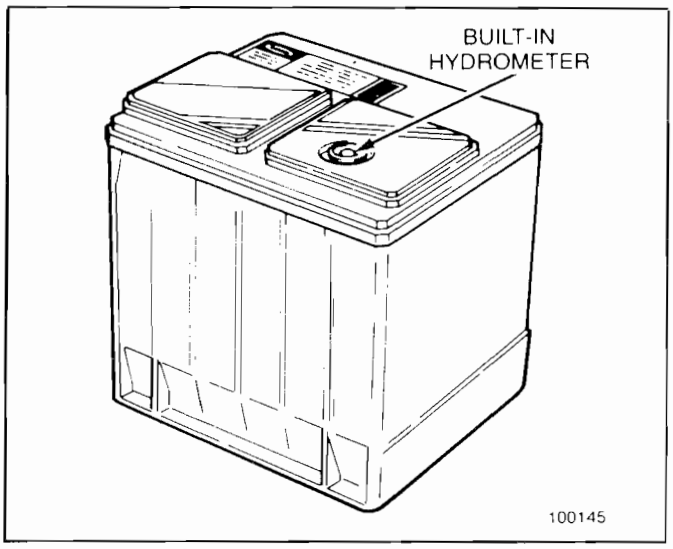
SECTION 6D1

BATTERY

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GENERAL DESCRIPTION



6D1-1 Sealed Top Battery

The sealed battery (See Figure 6D1-1) is standard on all vehicles (See Specifications) at the end of each subsection. There are no vent plugs in the cover. The battery is completely sealed, except for two small vent holes in the side. These vent holes allow the small amount of gas produced in the battey to escape. The battery has the following advantages over conventional batteries:

1. No water addition for the life of the battery. 2. Overcharge protection. If too high a level voltage is applied to the battery, it will not accept as much current as a conventional battery. In a conventional battery, the excess voltage will still try to charge the battey leading to gassing, which causes liquid loss.
3. Not as liable to self-discharge as compared to a conventional battery. This is particularly important when a battery is left standing for long periods of time.
4. More power available in a lighter and smaller case.

The battery has three major functions in the electrical system.

First, it is a source of electrical energy for cranking the engine. Second, it acts as a voltage stabilizer for the electrical system. And third, it can, for a limited time, provide energy when the electrical load used exceeds the output of the generator.

GENERAL INFORMATION

COMMON CAUSES OF FAILURE

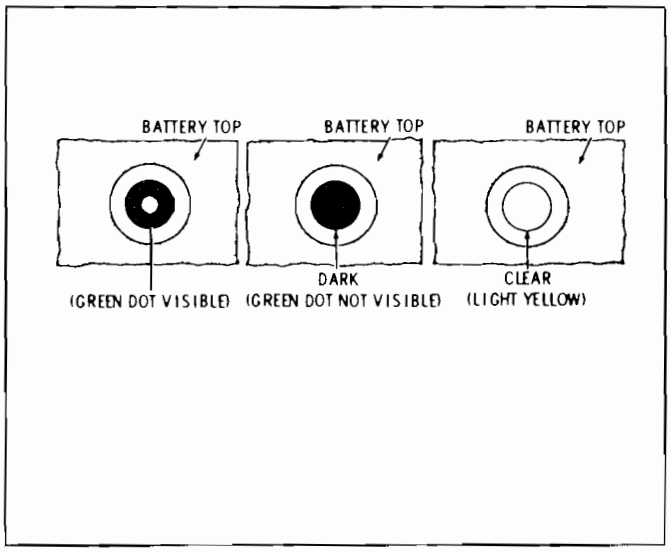
The battery is not designed to last indefinitely; however, with proper care, it will provide many years of service. If the battery test good but fails to perform satisfactorily in service for no apparent reason, the following are some of the more important factors that may point to the cause of trouble:

1. Accessories left on overnight.
2. Slow average driving speeds for short periods.
3. The vehicle electrical load is more than the generator output particularly with the addition of after market equipment.
4. Defects in the charging system such as electrical shorts, slipping fan belt, faulty generator or voltage regulator.
5. Battery abuse, including failure to keep the battery cable terminals clean and tight or loose

battery hold down. See On-Vehicle Service for torque specifications.

Visual Inspection

The external condition of the battery should be checked periodically for damage such as cracked cover or case.



6D1-2 Built-In Hydrometer

RATING

A battery has two ratings: (1) a reserve capacity rating at 27°C (0°F) which indicates the cranking load capacity. (See Specifications for specific battery ratings).

Built-In Hydrometer

The sealed battery has a built-in temperature compensated hydrometer in the top of the battery. This hydrometer is to be used with the following diagnostic procedure. When observing the hydrometer, make sure that the battery has a clean top. A light may be needed in some poorly-lit areas.

Under normal operation, two indications can be seen (See Figure 6D1-2):

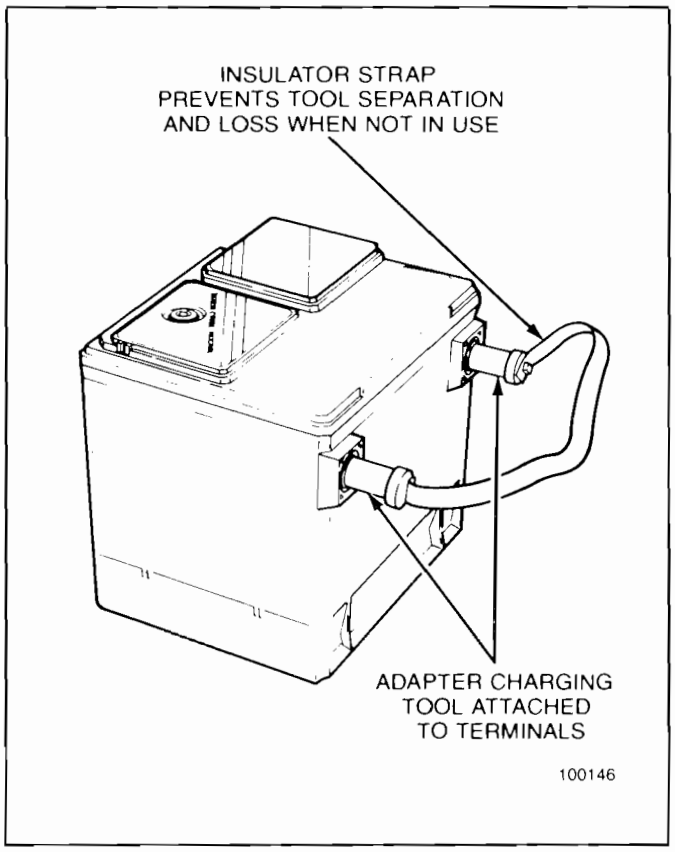
1. GREEN DOT VISIBLE

   Any green appearance is interpreted as a "green dot" and the battery is ready for testing.
2. DARK; GREEN DOT NOT VISIBLE

   If there is a cranking complaint, the battery should be tested as described in the Diagnosis Section. The charging and electrical systems should also be checked at this time.

   Occasionally, a third condition may appear:
3. CLEAR OR LIGHT YELLOW

   This means the fluid level is below the bottom of the hydrometer. This may have been caused by excessive or prolonged charging, a broken case, excessive tipping or normal battery wearout. When finding a battery in this condition, it may indicate high charging voltage caused by a faulty charging system and therefore, the charging and electrical system may need to be checked. If a cranking complaint exists and is caused by the battery, it should be replaced.



6D1-3 Side Terminal Battery Adapters

DIAGNOSIS

The following procedure should be used for testing batteries:

1. **VISUAL INSPECTION**

   Check for obvious damage, such as cracked or broken case or cover, that could permit loss of electrolyte. If obvious damage is noted, replace the battery. Determine cause of damage and correct as needed. If not, proceed to Step 2.
2. **HYDROMETER CHECK (FIG. 6D1-2)**

   a. GREEN DOT VISIBLE

   -go to Step 3.

   b. DARK; GREEN DOT NOT VISIBLE.

   Chage the battery as outlined under Charging Procedure and proceed to Step 3.
3. **LOAD TEST**

   Load testing may require use of battery side terminal adapters to insure good connections (See

Figure 6D1-3). On diesel engine vehicles, disconnect and test each battery separately.

a. Connect a voltmeter and a battery load tester across the battery terminals.

b. Apply 300 ampere load for 15 seconds to remove surface charge from the battery. Remove load.

c. Wait 15 seconds to let battery recover and apply specified load from load test chart (See Specific Vehicle subsection). Read voltage after 15 seconds, then remove load.

d. If voltage does not drop below the minimum listed in Figure 6D-12, the battery is good and should be returned to service. Temperature of the battery will change the minimum voltage to pass the load test. See Figure 6D1-4 and estimate the temperature the battery has been exposed to for the last several hours.

ESTIMATED TEMPERATURE	MINIMUM VOLTAGE
70° F. (21° C.)	9.6
50° F. (10° C.)	9.4
30° F. (0° C.)	9.1
15° F. (−10° C.)	8.8
0° F. (−18° C.)	8.5
0° F. (BELOW: −18° C.)	8.0

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6D1-4 Temperature vs. Voltage Drop

Battery	Test Load (Amps)
70-500	250

6D1-5 Load Test Values

ON-VEHICLE SERVICE

BATTERY

Replacement

1. Disconnect negative battery cable.
2. Disconnect positive battery cable.
3. Remove battery hold down clamp (See Figure 6D-14).
4. Follow procedure in Figure 6D-15 to reposition fender for battery removal.
5. Lift battery up and out of vehicle.
6. Reverse this procedure to install.
7. Torque battery cables to 12 N·m (19 lb. ft.).

BATTERY CHARGING

When it is necessary to charge the battery, the following safety precautions must be followed:

1. DO NOT CHARGE battery if hydrometer is clear or light yellow. Replace battery.
2. If the battery feels hot 52°C (125°F) or if violent gassing or spewing of electrolyte through the vent hole occurs, discontinue charging or reduce charging rate.

Charging Procedure

1. Batteries with green do showing do not require charging unless they have just been discharged (such as in cranking vehicle).
2. When charging sealed-terminal batteries out of vehicle, install adapter kit ST-1201 or 1846855 or equivalent. (Refer to Figure 6D1-3). Post-type batteries need no adapters.
3. Make sure all charger connections are clean and tight.
4. For best results, batteries should be charged while electrolyte and plates are at room temperature. A battery that is extremely cold may not accept current for several hours after starting charger.
5. Charge battery until green dot appears (See Charing Time Required5 Battery should be checked every half-hour

   while charging. Tipping or shaking battery may be necessary to make green dot appear.
6. After charging, battery should be tested as outlined in BATTERY TESTING.

Charging Time Required:

The time required to charge a battery will vary dependent upon the following factors:

- Size of Battery - A completely discharged large heavy duty battery requires more than twice the recharging as a completely discharged small passenger car battery.
- Temperature - A longer time will be needed to charge any battery at 0°F than at 80°F. When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first, then in time, the battery will accept a higher rate as the battery warms.
- Charger Capacity - A charge which can supply only five ampers will require a much longer period of charging than a charger that can supply 30 amperes or more.
- State-Of-Charge - A completely discharged battery requires more than twice as much charge as a one-half charged battery. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the

current accepted by the battery is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.

Charging A Completely Discharged Battery

The following procedure should be used to recharge a very flat or completely discharged battery.

Unless the procedure is properly followed, a perfectly good battery may be needlessly replaced.

1. Measure voltage at battery terminals with an accurate voltmeter. If below 10 volts, then the charge current will be very low and it could take some time before it accepts a current in excess of a few milliamperes. Such low current may not be detectable on ammeters available in the field.
2. Set battery charger on high setting.
3. Some chargers feature polarity protection circuitry which prevents charging unless the charger leads are connected to the battery terminals correctly. A completel discharged battery may not have enough voltage to activate this circuitry, even though leads are connected properly, making it appear that the battery will not accept charging current. Therefore, follow the specific charger manufacturer's instruction telling how to bypass or override the circuitry so that the charger will turn on and charge a low-voltagelbattery.
4. Battery chargers vary in the mount of voltage and current they provide. The time required for the battery to accept measurable charger current at various voltages may be as follows:
   - VOLTAGE
     A. 16.0 or more -- Up to 4 hours
     B. 14.0 - 15.9 -- Up to 8 hours
     C. 13.9 or less -- Up to 16 hours

   If the charge current is still not measurable at the end of the above charging times, the battery should be replaced.

   If the charge current is measurable during the charging time, the battery is considered to be good and charging should be completed in the normal manner.
5. It is important to remember that a completely discharged battery must be recharged for a sufficient number of ampere hours (AH) to restore it to a useable state. As a general rule of thumb, using the reserve capacity rating (RC) (refer to specification) of the battery as the number of ampere hours of charge which will usually bring the green dot into view. For example, if battery is rated at 75 RC minutes, it would be completely recharged as follows:
   - 10 ampere charge x 7-1/2 hours ¡75 AH or
   - 25 ampere charge x 3 hours ¡75 AH, etc.
6. It is recommended that any battery recharged by this procedure be LOAD TESTED to establish serviceablility.

Jump Starting In Case Of Emergency With Auxiliary

NOTICE: Do not push or tow the vehicle to start. Damage to the emission system and/or to other parts of the vehicle may result.

NOTICE: Both booster and discharged battery should be treated carefully when using jumper cables. Follow the procedure outlined below, being careful not to cause sparks:

CAUTION: Departure from these conditions or the procedure below could result in: (1) Serious personal injury (particularly to eyes) or property damage from such causes as battery explosion, battery acid, or electrical burns; and/or 42) damage to electronic components of s either vehicle.
CAUTION: Never expose battery to open flame or electric spark-batteries generate a gas which is flammable and explosive.
CAUTION: Remove rings, watches and other jewelry. Wear approved eye protection.
CAUTION: Do not allow battey fluid to contact eyes, skin, fabrics, or painted surfaces - fluid is a corrosive acid. Flush any contacted area with water immediately and thoroughly. Be careful that metal tools or jumper cables do not contact the positive battery terminal (or metal in contact with it) and any other metal on the vehicle, because a short circuit could occur. Batteries should always be kept out of the reach of children.

1. Set parking brake and place automatic transmission in "PARK" (NEUTRAL for manual transmission). Turnoff the ignition, turn off lights and all other electrical loads.
2. Check the built-in hydrometer. If it is clear or light yellow, replace the battery.

NOTICE: When jump starting a diesel engine vehicle with charging equipment, be sure equipment used is 12-volt and negative ground. Do not use 24-volt charging equipment. Using such equipment can cause serious damage to the electrical system or electronic parts.

3. Attach the end of one jumper cable to the positive terminal of the booster battery and the other end of the same cable to the positive terminal of the discharged battery. Do not permit vehicles to touch each other as this could cause a ground connection and counteract the benefits of this procedure. (Use 12-volt battery only jump start the engine.)).
4. Attach one end of the remaining negative cable to the negative terminal of the booster battery, and the other end to a solid engine ground (such as A/C compressor bracket or generator

mounting bracket) at least 18 inches from the battery of the vehicle being started. **(DO NOT CONNECT DIRECTLY TO THE NEGATIVE TERMINAL OF DEAD BATTERY).**

5. Start the engine of the vehicle that is providing the jump start and turn off electrical accessories. Then start the engine in the vehicle with the discharged battery.
6. Reverse these directions exactly when removing the jumper cables. The negative cable must be disconnected from the engine that was jump started first.

BATTERY STORAGE

Today's vehicles have several electronic devices which result in very small but continuous current drains on their batteries, commonly referred to as "parasitic loads." Vehicles that are not used for an extended period of time may develop extremely discharged and/or permanently damaged batteries resulting from these parasitic loads. Discharged batteries can freeze at temperatures as high as 20°F causing permanent damage.

To alleviate this condition, the negative battery cable should be disconnected on vehicles which are not going to be in service within a 30-day period. If this is not possible, batteries should be recharged periodically, every 30-60 days, until the green dot is visible.

NOTICE: The ignition switch must be off when connecting or disconnecting battery cables or chargers. Failure to do so may overstress or damage the ECM or other electronic components.

BATTERY DIAGNOSIS - VEHICLE RELATED CONDITION

After the battery has been charged or tested and has proven to be a good battery, the cause of the no-start or slow cranking condition must be determined and corrected to avoid comebacks. If no obvious cause is evident, the vehicle's electrical system should be diagnosed using the following steps:

Step 1 - Check Cranking System

If the battery has tested OK on a load test and the vehicle still will not start or is difficult to start, the cranking system should be checked; otherwise, proceed to step 2.

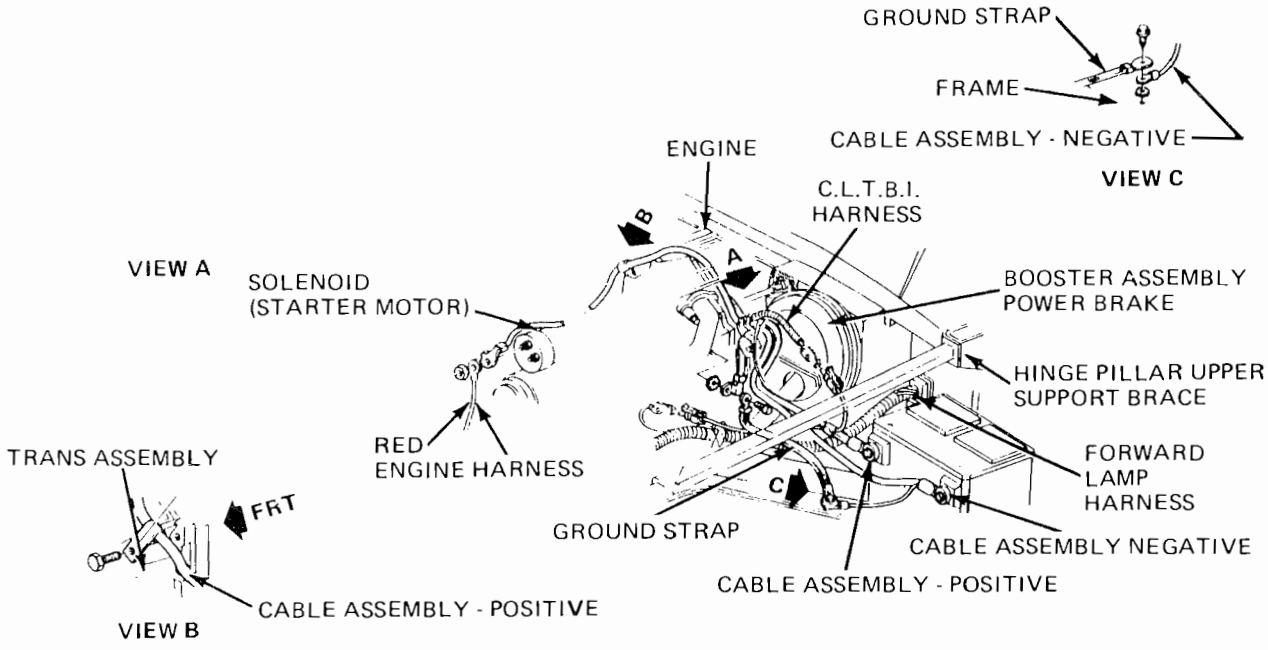
Check the visual condition of the battery, battery cables, and connections, and check for the presence of the green dot on the built-in hydrometer. If the built-in hydrometer is dark ("black eye", green dot not present), charge and test the battery as described previously before continuing the cranking system diagnosis. To check the cranking system to verify proper operation, a simple cranking test can be done as follows:

a. Prevent the car from starting during cranking by removing the fuel pump fuse.
b. Connect a voltmeter from the positive terminal of the starter to ground.
c. Turn key to Start position and read voltmeter while cranking, using care not to run the starter motor continuously for over 30 seconds. If starter is run for 30 seconds, it must be allowed to cool for at least three minutes before cranking to avoid possible damage.
d. If the voltage noted in step c above is less than 9.6 volts at 21°C (70°F) during cranking and the battery has already checked OK (greater than 9.6 volts on load test), an excessive current draw from the starter or an excessive voltage drop in the starter cables could be the cause of low cranking voltage; proceed to step e below. If the voltage measured while cranking is greater than 9.6 volts (i.e., the starting system checks OK), proceed to step f below.
e. Diagnose the starting system as described later in this section, noting in particular the voltage drops in the system which would indicate either excessive resistance or poor or corroded connections. The threaded end of the battery cable screw and the lead contact faces on the battery terminals and cables should be cleaned with a wire brush if necessary, and the cables should be properly torqued to 12 newton-meters (105 in. lbs.).
f. Reinsert the fuse removed in step 1a.
g. If the starting system checks above reveal no abnormal conditions, but excessive cranking is required to start the car, the cause should be diagnosed and corrected to reduce battery demands. Two possible causes for excessively long cranks are the engine fuel system or the distributor system.

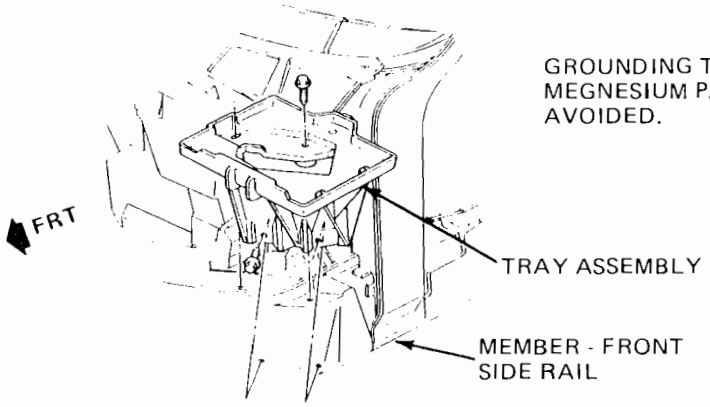
Step 2 - Check For Current Drain

If a battery requires recharging and no cause is evident (i.e., headlamps left on, extended vehicle storage, etc.), the vehicle should be diagnosed for excessive current drain. Excessive current drain occurring while a car is parked (ignition switch off) can cause a discharged battery, which could be improperly diagnosed as one which will not hold a charge. Current drain can be accurately checked using digital multimeter J-29125 or equivalent and two alligator clip-type jumper wires as follows:

a. Disconnect the negative battery cable.
b. Install a battery side terminal adapter (AC Delco ST-1201 or equivalent) in the negative terminal of the battery.

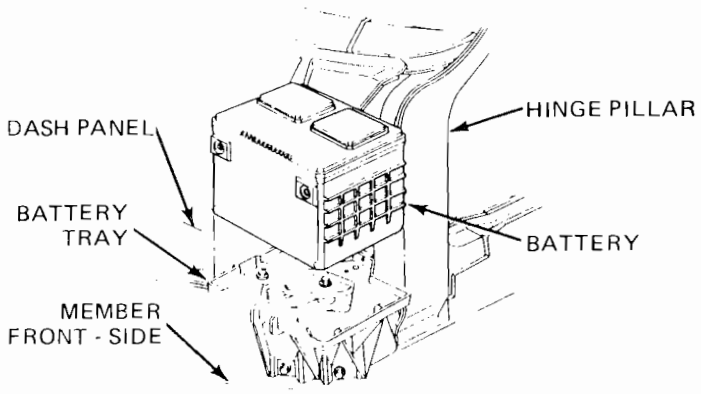


NOTICE: BATTERY MUST NOT BE CONNECTED TO BATTERY CABLE WITH IGNITION SWITCH ON. ECM DAMAGE MAY RESULT.

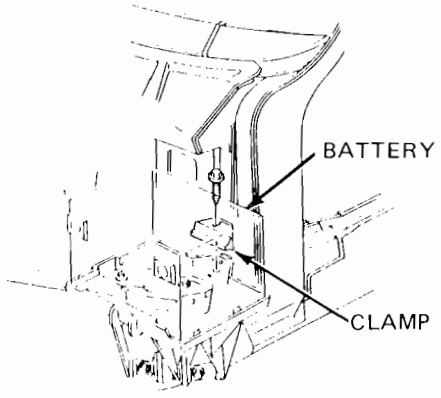


GROUNDING TO ALUMINUM OR MEGNESIUM PARTS SHOULD BE AVOIDED.

BATTERY TRAY ATTACHMENT

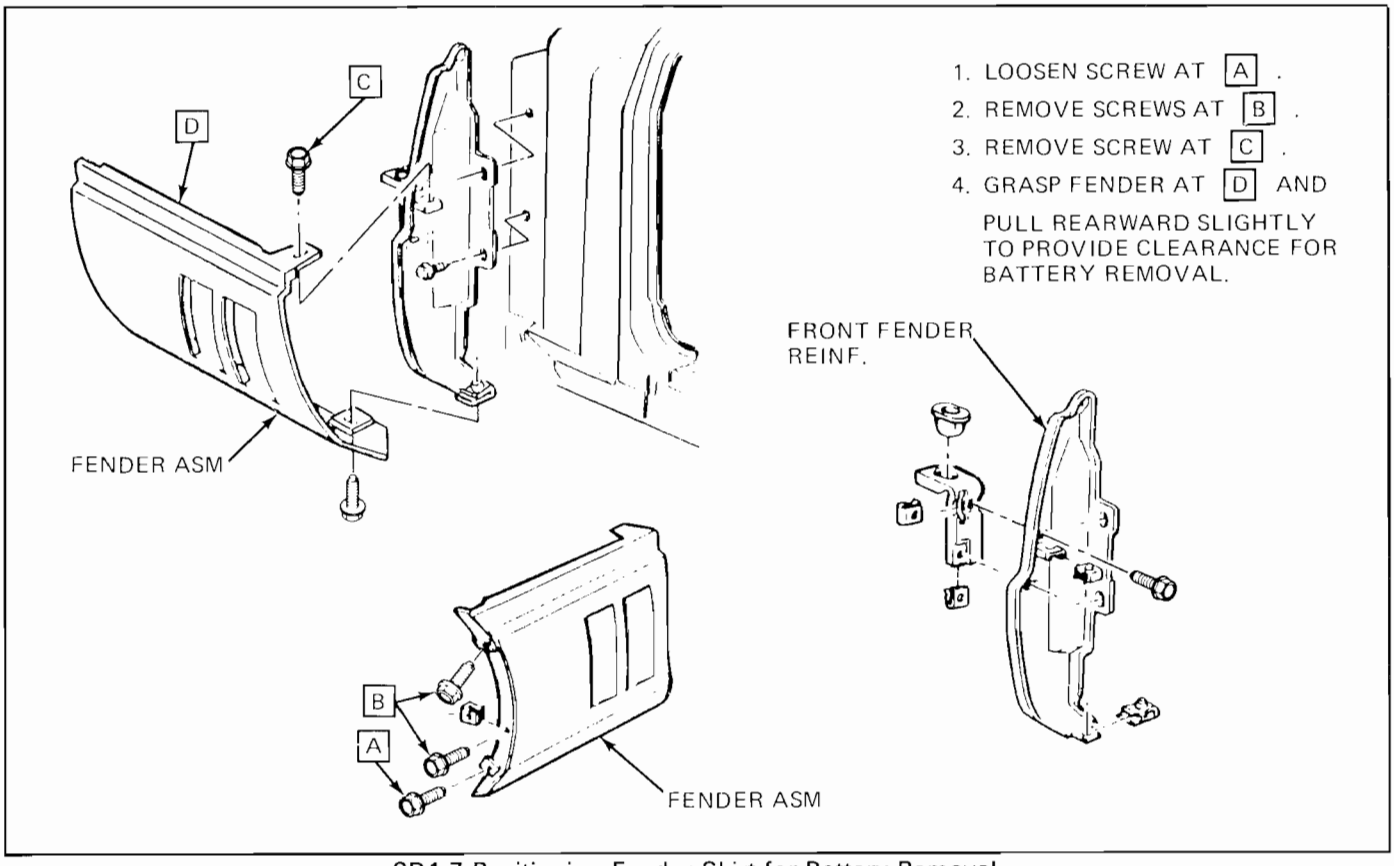


BATTERY MOUNTING



BATTERY HOLD DOWN CLAMP

6D1-6 Battery Cables and Battery Mounting



6D1-7 Positioning Fender Skirt for Battery Removal

c. Install a 3/8-16 nut with standard threads (16 UNC) on the negative battery cable terminal attaching screw to assure a good electrical contact with the lead face on the cable for testing. Yellow or black finish nuts are generally non-conductive and should not be used.
d. Set multimeter J-29125 to DC, MA (milliamps), and the 2,000 range.
e. With all lights, accessories, and the ignition switch off, connect the multimeter in series with the battery.

A current draw of 50 milliamps or less indicates that all lights and accessories are off and there is no unexplained current draw.

Possible causes of excessive current draw are such conditions as a misadjusted trunk lamp switch, a glove box lamp which stays on due to a misadjusted door, a pinched or grounded wire, etc. A very small current draw (under 50 milliamps) is normal for the clock , the memory electronics in the radio, the voltage regulator, and ECM.

Step 3 - Check Charging System

If a battery becomes discharged and no excessive current drain is found in step 2 above, the operation of the charging system should be checked as follows:

a. Check for proper operation of the generator tell-tale instrument panel lamp. Replace the bulb or fuse or repair the wiring as necessary.
b. Check belt tension, using belt tension gage J-23600, against the specifications given in Section 6B.
c. Check the charging system and battery wiring, including the connectors at the generator and bulkhead, and battery terminals for cleanlinesss and tightness.
d. Use a generator tester or the generator diagnostic procedure outlined in this section, to differentiate between failures in the generator or the wiring harness as necessary.
e. If in doubt concerning the output of the generator, check generator ouput as described in this section If generator output is within 10 amperes of rated output, the generator is not the cause and should not be replaced.

BATTERY DIAGNOSIS - DRIVER RELATED CONDITION

If no cause is found for a discharged battery and the battery tests good, a light may have been left on, or the driving habits of the owner may be such that, especially with many short trips and repeated starts, the generator does not get a chance to recharge the battery between starts. If this situation is suspected, the driver should be instructed in ways to reduce battery drain.

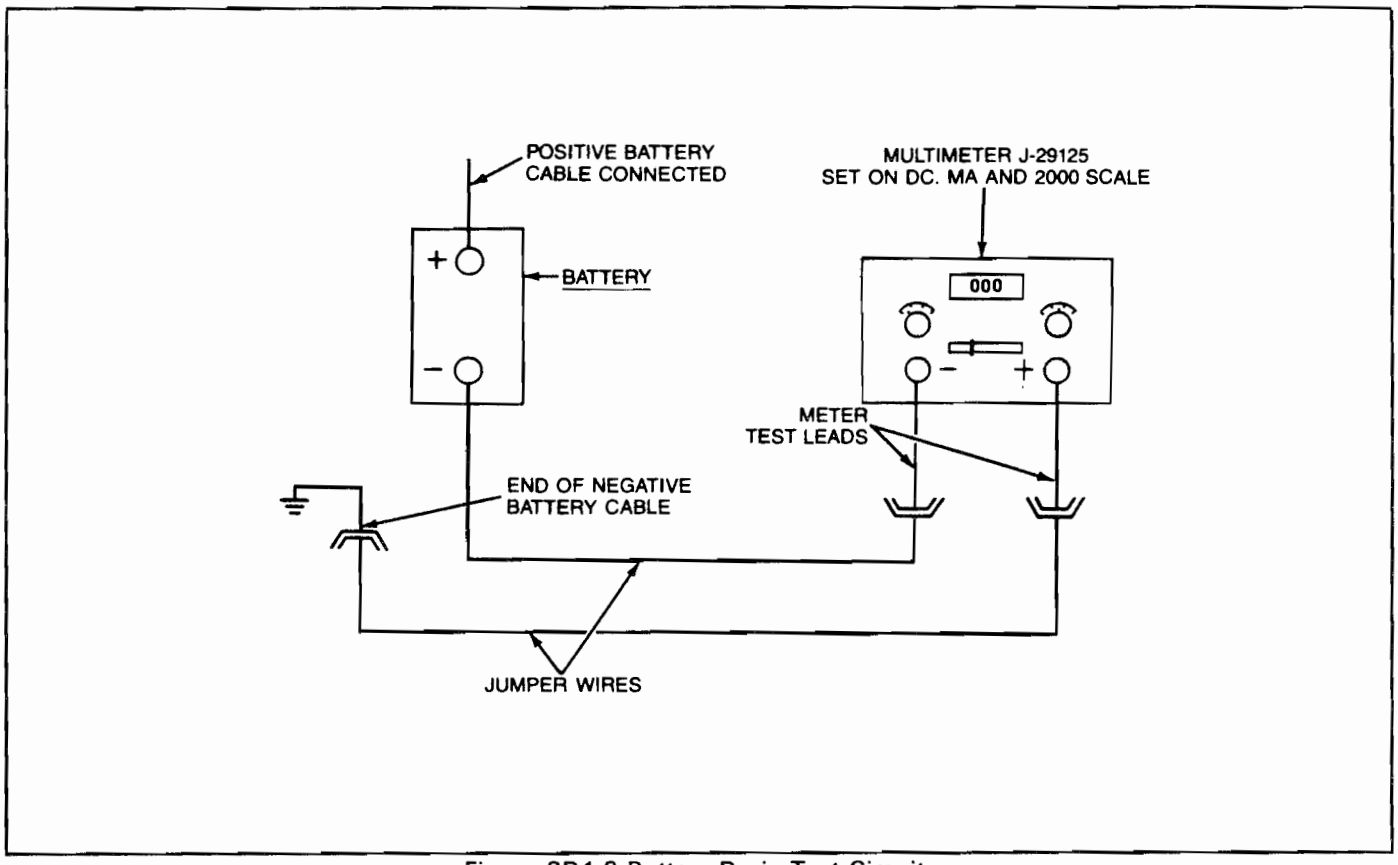


Figure 6D1-8 Battery Drain Test Circuit

SPECIFICATIONS

MODEL NO.	APPLICATION	COLD CRANK RATE @ 0°F (-18°C)	AMPS FOR LOAD TEST	25 AMP. RESERVE CAPACITY (MINUTES)
(1981320) 70-500	350 V-8	500	250	90

SECTION 6D2

CRANKING SYSTEM

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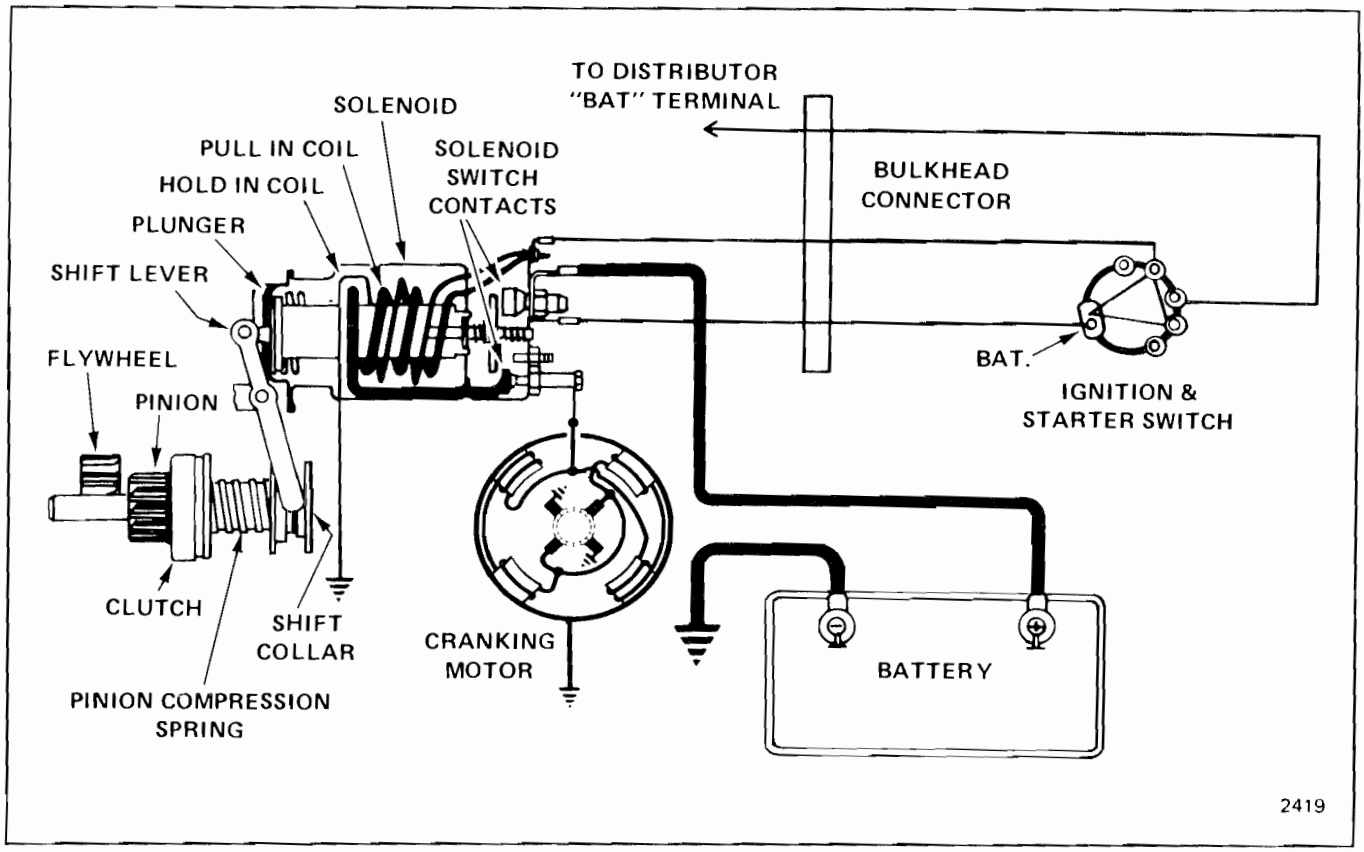


Figure 6D2-1 Cranking Circuit

GENERAL DESCRIPTION

CRANKING CIRCUIT

The cranking circuit consists of the battery, starting motor, ignition switch, and related electrical wiring. These components are connected electrically as shown in Figure 6D-36. Only the starting motor will be covered in this portion.

STARTING MOTOR

Fig. 6D2-2 shows a cross sectional view of the 10 MT Motor.

In the basic circuit shown in Figure 6D-38, the solenoid windings are energized when the switch is closed. The resulting plunger and shift lever movement causes the pinion to engage the engine flywheel ring gear and the solenoid main contacts to close, and cranking takes place. When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage. To prevent excessive overrun, the switch should be opened immediately when the engine starts.

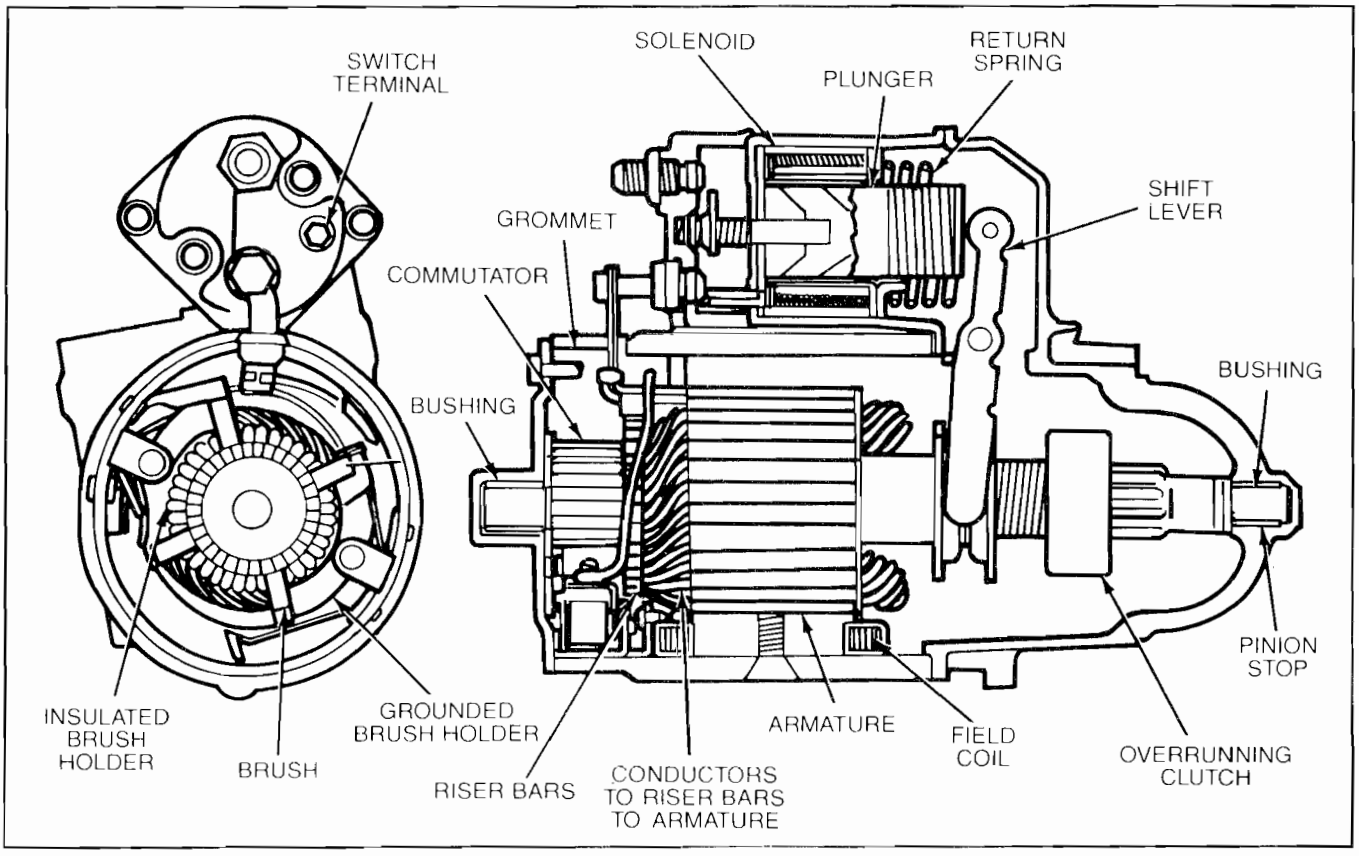


Fig. 6D2-2 - Cross Section of 10MT Starting Motor

STARTER

Removal

1. Disconnect battery ground cable.
2. Raise vehicle and disconnect starter wires.
3. Remove starter brace nut.
4. Remove flywheel cover.
5. Remove starter mounting bolts.
6. Remove starter.
7. Reverse procedure to install.

DIAGNOSIS

Before removing any unit in a cranking circuit for repair, the following checks should be made:

Battery: To determine the condition of the battery, follow the testing procedure outlined in the Battery Section.

Wiring: Inspect the wiring for damage. Inspect all connections to the cranking motor, solenoid, ignition switch, and battery, including all ground connections. Clean and tighten all connections as required.

Solenoid and Ignition Switch: Inspect all switches to determine their condition.

Starter Motor Noise: To correct starter motor noise during starting, use the following procedure:

1. Refer to Starter Motor Noise Diagnosis.
2. If the complaint is similar to problem categories 1 or 2, correction can be achieved by proper "shimming" as follows:
   a. Check flywheel for damage-bent, unusual wear, etc.
   b. Start engine and carefully touch outside diameter of rotating flywheel ring gear with chalk or crayon to show high point of tooth runout after engine is turned off. Turn engine off and rotate flywheel so that the marked teeth are in the area of the

	PROBLEM	CAUSE
1.	HIGH PITCHED WHINE DURING CRANKING (BEFORE ENGINE FIRES) BUT ENGINE CRANKS AND FIRES OKAY.	DISTANCE TOO GREAT BETWEEN STARTER PINION AND FLYWHEEL.
2.	HIGH PITCHED "WHINE" AFTER ENGINE FIRES, AS KEY IS BEING RELEASED. ENGINE CRANKS AND FIRES OKAY. THIS INTERMITTENT COMPLAINT IS OFTEN DIAGNOSED AS "STARTER HANG-IN" OR "SOLENOID WEAK."	DISTANCE TOO SMALL BETWEEN STARTER PINION AND FLYWHEEL. FLYWHEEL RUNOUT CONTRIBUTES TO THE INTERMITTENT NATURE.
3.	A LOUD "WHOOP" AFTER THE ENGINE FIRES BUT WHILE THE STARTER IS STILL HELD ENGAGED. SOUNDS LIKE A SIREN IF THE ENGINE IS REVVED WHILE STARTER IS ENGAGED.	MOST PROBABLE CAUSE IS A DEFECTIVE CLUTCH. A NEW CLUTCH WILL OFTEN CORRECT THIS PROBLEM.
4.	A "RUMBLE", "GROWL" OR (IN SEVERE CASES) A "KNOCK" AS THE STARTER IS COASTING DOWN TO A STOP AFTER STARTING THE ENGINE.	MOST PROBABLE CAUSE IS A BENT OR UNBALANCED STARTER ARMATURE. A NEW ARMATURE WILL OFTEN CORRECT THIS PROBLEM.

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Figure 6D2-2 Starter Motor Noise Diagnosis

starter pinion gear.

c. Disconnect negative battery cable to prevent inadvertent cranking of engine.

d. Check pinion to flywheel clearance, as shown in Figure 6D2-3, by using a wire gage of .508 mm (.020") minimum thickness (or diameter). Center the pinion tooth between the flywheel teeth and gage, and not in the corners, where a misleading larger dimension may be observed. If the clearance is under this minimum, shimming the starter away from the flywheel is required. Shims .381 mm (.015") thick, installed as shown in Figure 6D2-3, will increase the clearance by approximately .127 mm (.005"). More than one shim may be required.

e. If the clearance is grossly over .508 mm (.020") (in the vicinity of 1.524 mm (.060") or more), shimming the starter towards the flywheel is required. (This is generally the problem causing broken flywheel teeth or starter housings.) Shimming the starter towards the flywheel can be accomplished by shimming only the outboard starter mounting pad. A shim of .381 mm (.015") thickness at this location will decrease the clearance by approximately .254 mm (.010").

If normal starter shims are not available, they can be improvised from plain washers or other suitable material.

3. Problem categories 3 and 4 may require starter motor replacement or repair in some cases.

Starter Motor: If the battery, wiring and switches are in satisfactory condition, and the engine is known to be functioning properly, remove the motor and follow the test procedures outlined below.

Never operate the cranking motor more than 30 seconds at a time without pausing to allow it to cool for at least two minutes. Overheating, caused by excessive cranking, will seriously damage the cranking motor.

A general diagnosis is covered in Figure 6D-1 and 6D-2. Once a problem has been traced to the starter, proceed to the test procedure outlined in the unit repair section.

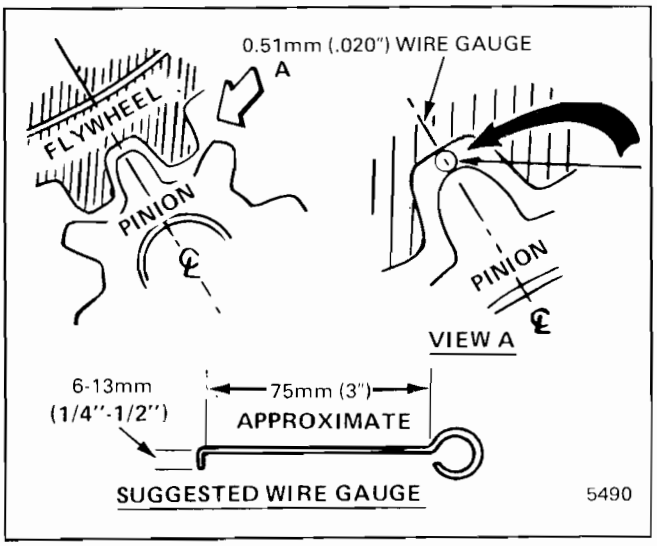


Figure 6D2-3 Meshing Starter and Flywheel Teeth

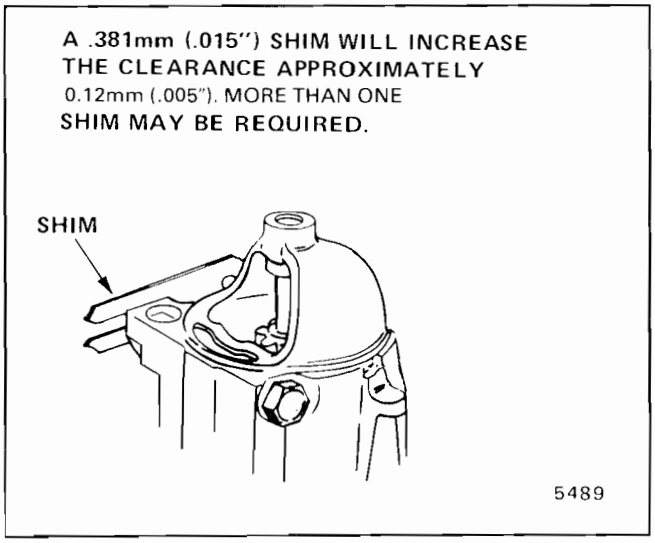


Fig. 6D2-4 Flywheel to Pinion Clearance

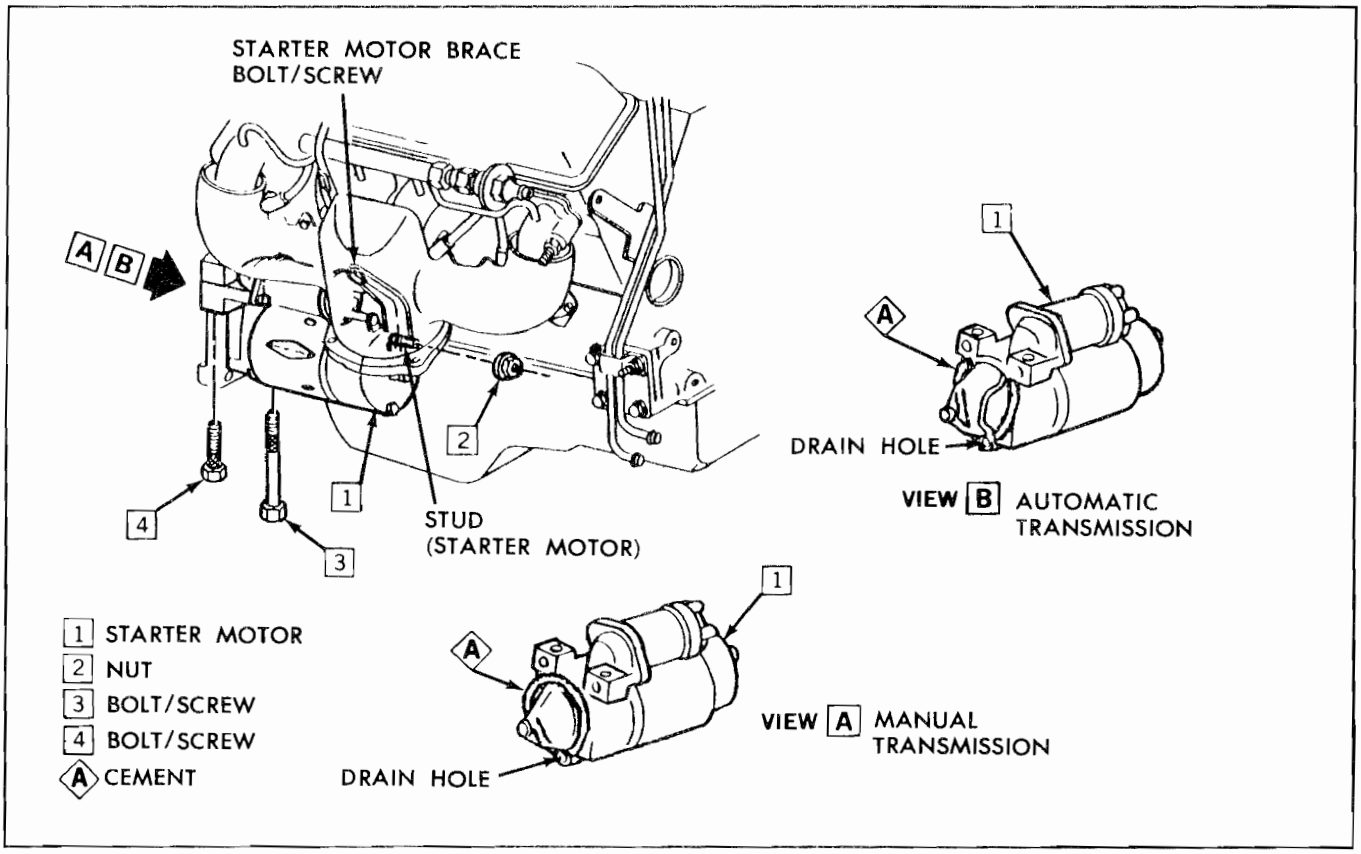


Fig. 6D2-5 - Starter Motor Mounting

ON-CAR SERVICE

STARTER MOTOR MOUNTING

Starting motors do not require lubrication except during overhaul.

When the motor is disassembled for any reason, lubricate as follows:

1. The armature shaft and drive end and commutator end bushings should be coated with No. 1960954 lubricant or equivalent.
2. The roll type overrunning clutch requires no lubrication. However, the drive assembly should be wiped clean. Do not clean in a degreasing tank or with grease dissolving solvents; this will dissolve the lubricant in the clutch mechanism. Use silicon grease General Electric CG321, Dow Corning 33 Medium, or equivalent, on the shaft underneath the overrunning clutch assembly.
3. Avoid excessive lubrication.

UNIT REPAIR

The following illustrated procedure will be used to disassemble and reassemble the starter motor. Component checks are also included in this section.

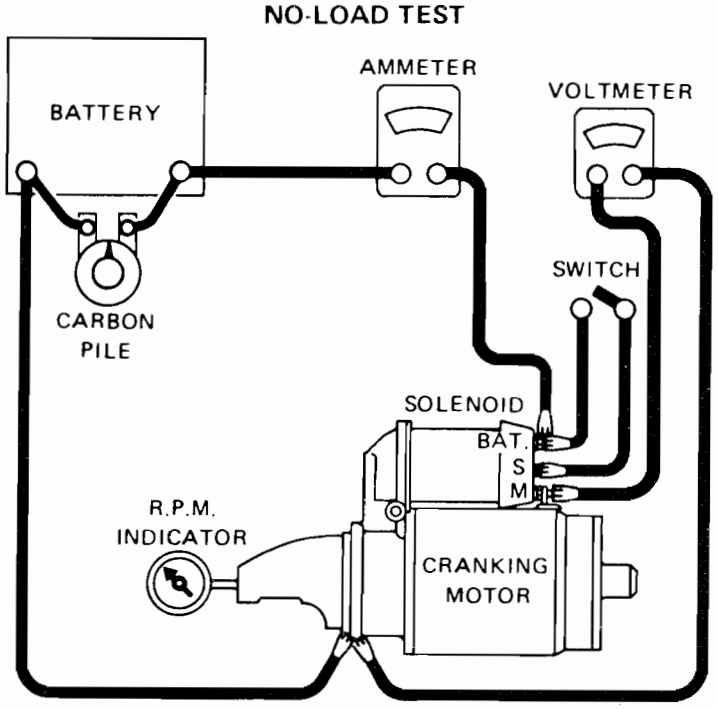
OVERRUNNING CLUTCH

1. Test overrunning clutch action. The pinion should turn freely in the overrunning direction. Check pinion teeth to see that they have not been chipped, cracked, or excessively worn. Replace assembly if necessary. Badly chipped pinion teeth may indicate chipped teeth on the ring gear. This should be checked under such conditions and replaced if necessary.
2. Check the overrunning clutch for slipping by leaving the clutch attached to the armature, wrap the armature with a shop towel and clamp the armature in a vice. Using a 12 point deep socket and torque wrench, put the socket on the clutch and turn counterclockwise. The clutch should not slip up to 68 N·m (50 ft. lb.) of torque. If it does, replace the clutch.

UNIT REPAIR

The following illustrated procedures will be used to disassemble, test, and reassemble the starter motor. Component checks are also included in this section.

STARTER MOTOR DISASSEMBLY, TEST AND REASSEMBLY (STARTER REMOVED FROM ENGINE)



With the starter motor removed from the engine, the pinion should be checked for freedom of operation by turning it on the screw shaft. The armature should be checked for freedom of rotation by prying the pinion with a screwdriver. If the armature does not turn freely, the motor should be disassembled immediately. However, if the armature does rotate freely, the motor should be given a no-load test before disassembly.

Make connections as shown. Close the switch and compare the RPM, current, and voltage readings with the specifications If the specified current draw does not include the solenoid, deduct from the ammeter reading the specified current draw of the solenoid hold-in winding. Make disconnections only with the switch open. Use the test results as follows:

1. Rated current draw and no-load speed indicates normal condition of the starter motor.

2. Low free speed and high current draw indicates:

- Too much friction — tight, dirty, or worn bearings, bent armature shaft allowing armature to drag.
- Shorted armature. This can be further checked on a growler after disassembly.
- Grounded armature or fields. Check further after disassembly.

3. Failure to operate with high current draw indicates:

- A direct ground in the terminal or fields.
- "Frozen" bearings (this should have been determined by turning the armature by hand).

4. Failure to operate with no current draw indicates:

- Open field circuit. This can be checked after disassembly by inspecting internal connections and tracing circuit with a test lamp.
- Open armature coils. Inspect the commutator for badly burned bars after disassembly.
- Broken brush springs, worn brushes, high insulation between the commutator bars or other causes which would prevent good contact between the brushes and commutator.

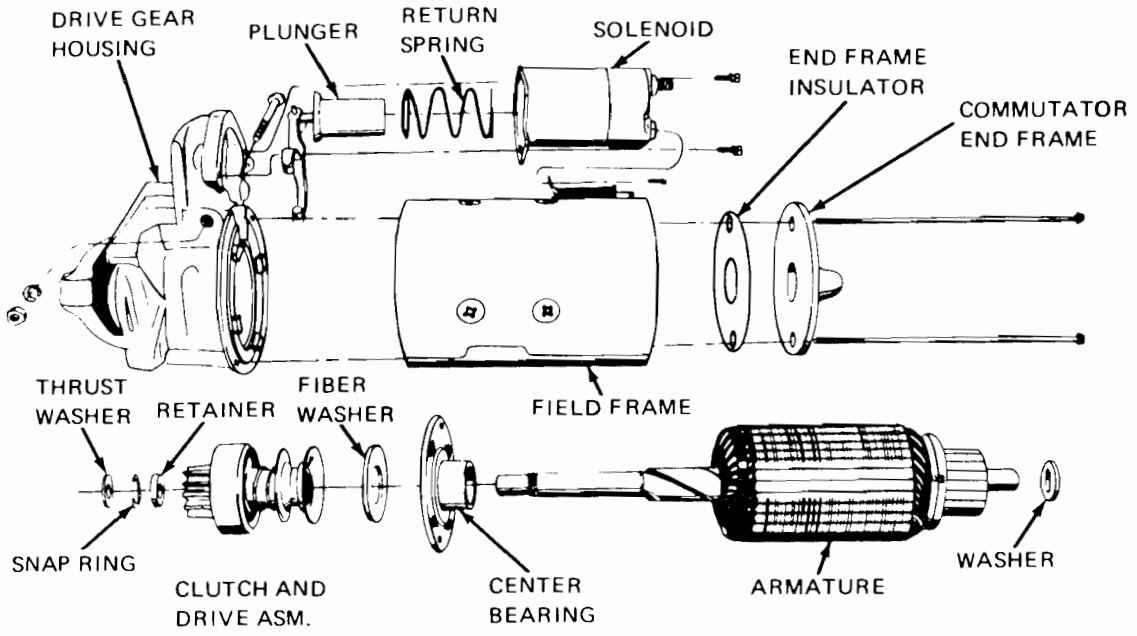
5. Low no-load speed and low current draw indicates:

- High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under Number 4.

6. High free speed and high current draw usually indicate shorted fields. If shorted fields are suspected, replace the field coil assembly. Also check for shorted armature, using a growler.

Figure 6D2-6 -- Starter Unit Repair - 1 of 6

STARTER DISASSEMBLY

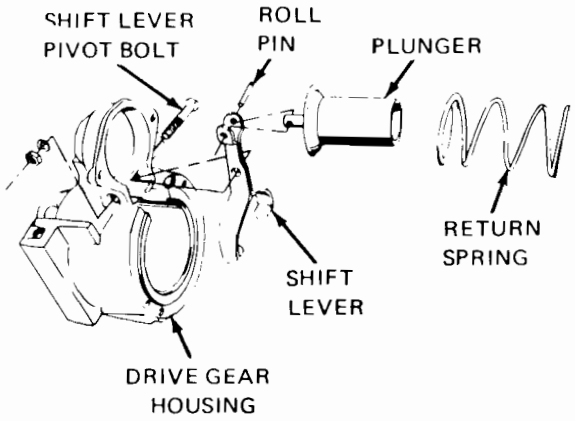


7. Remove screw from field coil connector and solenoid mounting screws. Rotate solenoid 90° and remove along with plunger return spring. Solenoid may now be serviced without further starter disassembly at this time.

8. Remove 2 through bolt, then remove commutator end frame (diesel only, remove insulator) and washer.

9. Remove field frame assembly from drive gear housing. (On diesel starter, armature remains in drive end frame.)

SHIFT LEVER AND PLUNGER REMOVAL

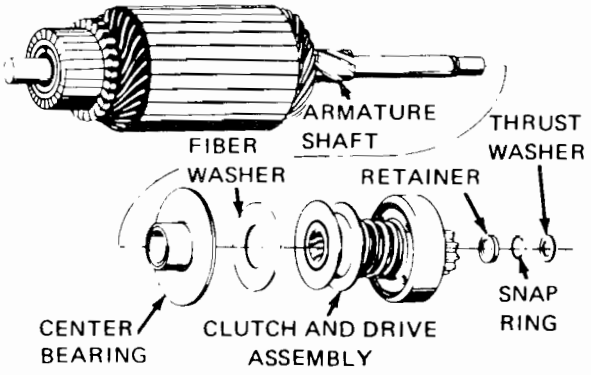


Steps 10 and 11 are required only on diesel starters.

10. Remove shift lever pivot bolt.

11. Remove center bearing screws (25 MT only) and remove drive gear housing from armature shaft. Shift lever and plunger assembly will now fall away from starter clutch.

REMOVE DRIVE ASSEMBLY FROM SHAFT



12. If necessary to remove overrunning clutch from armature shaft, proceed as follows:

a. Remove thrust washer or collar from armature shaft.

b. Slide a 5/8" deep socket or piece of pipe of suitable size over shaft against retainer as a driving tool. Tap tool to move retainer off snap ring.

c. Remove snap ring from groove in shaft. If snap ring is distorted, it will be necessary to use a new one on reassembly.

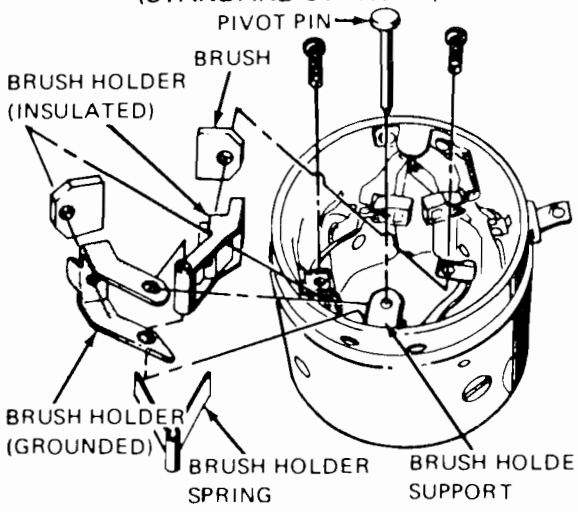
d. Remove retainer, clutch assembly (also fiber washer and center bearing on diesel) from armature shaft.

13. The shift lever and plunger may be disassembled at this time by removing the roll pin.

Figure 6D2-7 -- Starter Unit Repair - 2 of 6

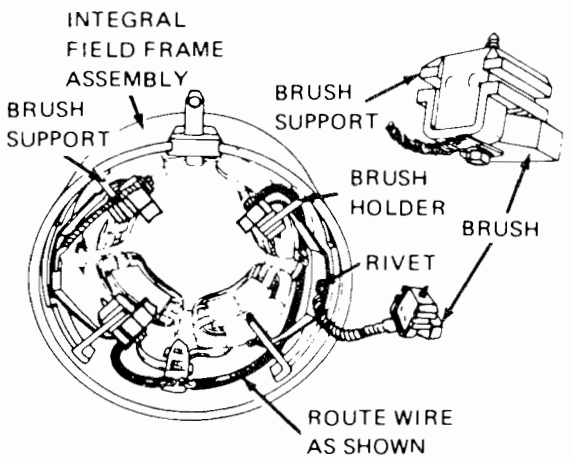
REPLACE BRUSH HOLDER

(STANDARD STARTER)



14. If necessary to replace brush holder parts, proceed as follows:
   a. Remove brush holder pivot pin which positions one insulated and one grounded brush.
   b. Remove brush spring.
   c. Replace brushes as necessary.

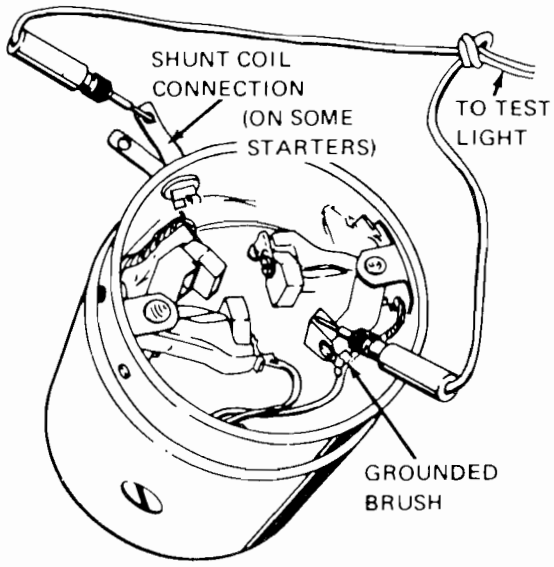
(SMALL 5MT STARTER)



   a. Remove brush holder from brush support.
   b. Remove screw from brush holder and separate brush and holder.
   c. Inspect brush holder for wear or damage.
   d. Replace brushes and/or holders as necessary.

CLEANING INSPECTION AND TESTS

TESTING SHUNT COIL FOR OPEN



15. Clean all starting motor parts, but DO NOT USE GREASE DISSOLVING SOLVENTS FOR CLEANING THE OVERRUNNING CLUTCH, ARMATURE, AND FIELD COILS, solvent would dissolve the grease packed in the clutch and would damage armature and field coil insulation.

16. Inspect armature commutator, shaft and bushings, overrunning clutch pinion, brushes and springs for discoloration, damage or wear. Replace as required.

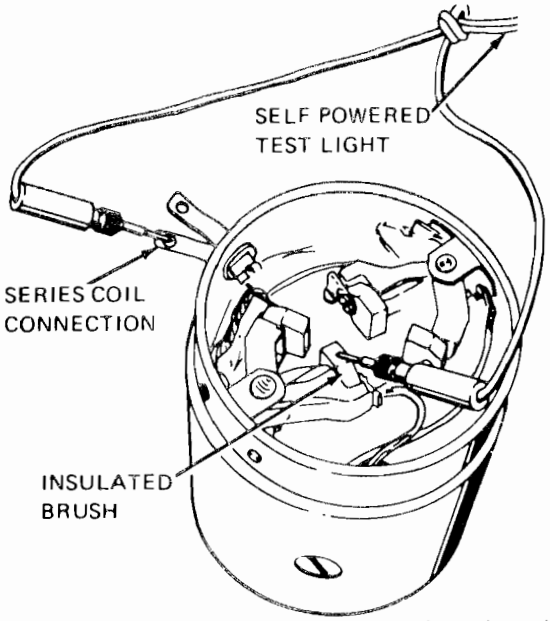
17. Check fit of armature shaft in bushing in drive housing. Shaft should fit snugly in the bushing. If the bushing is worn, it should be replaced.

18. Inspect armature commutator. If commutator is rough, it should be turned down. Do not undercut or turn to less than 1.650" O.D. Do not turn out-of-round commutators. Inspect the points where the armature conductors join the commutator bars to make sure they have a good connection. A burned commutator bar is usually evidence of a poor connection.

19. If test equipment is available:
   a. Check the armature for short circuits by placing on growler and holding hack saw blade over armature core while armature is rotated. If saw blade vibrates, armature is shorted. Recheck after cleaning between the commutator bars. If saw blade still vibrates, replace the armature.
   b. Using a test lamp, place one lead on the shunt coil terminal and connect the other lead to a ground brush. This test should be made from both ground brushes to insure continuity through both brushes and leads. If the lamp fails to light, the field coil is open and will require replacement.

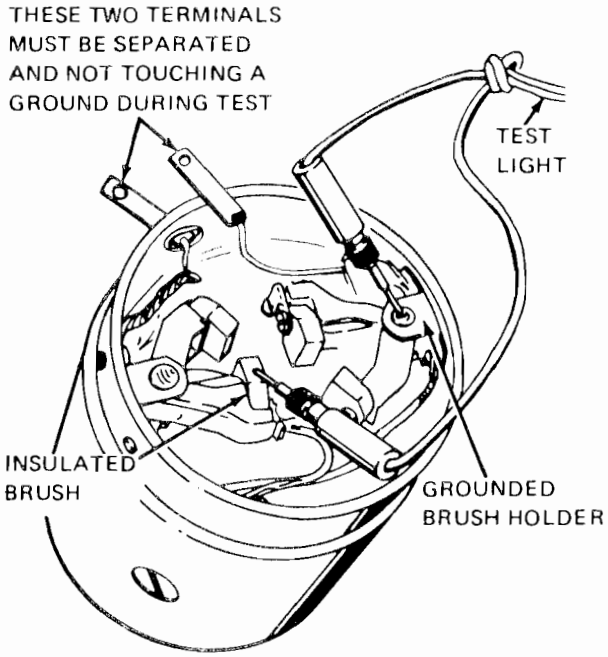
Fig. 6D-46 -- Starter Unit Repair - 3 of 6

TESTING SERIES COIL FOR OPEN



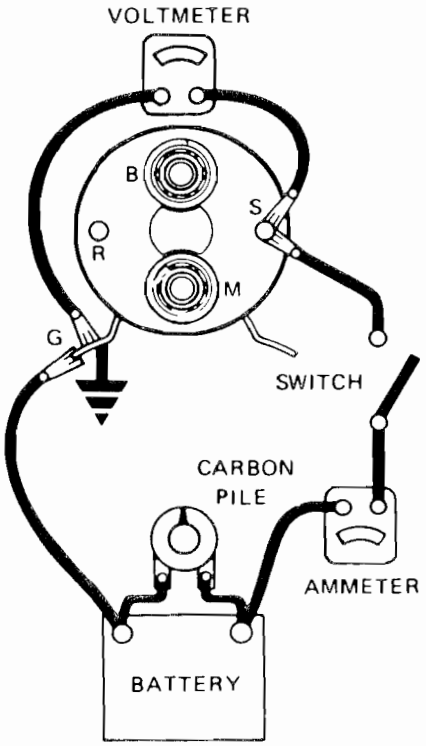
c. Using a test lamp, place one lead on the series coil terminal and the other lead on the insulated brush. If the lamp fails to light, the series coil is open and will require repair or replacement. This test should be made from each insulated brush to check brush and lead continuity.

TESTING SERIES COIL FOR GROUND



d. On starters with shunt coil, separtate series and shunt coil strap terminals during this test. Do not let strap terminals touch case or other ground. Using a test lamp place one lead on the grounded brush holder and the other lead on either insulated brush. If the lamp lights, a grounded series coil is indicated and must be repaired or replaced.

TESTING SOLENOID WINDINGS



e. Check the current draw of the solenoid winding as follows:

If solenoid is not removed from starting motor, the connector strap terminals must be removed from the terminal on the solenoid before making these tests. Complete tests in a minimum of time to prevent overheating of the solenoid.

To check hold-in winding, connect an ammeter in series with 12-volt battery and the "switch" terminal on the solenoid. Connect a voltmeter to the "switch" terminal and to ground. Connect carbon pile across battery. Adjust the voltage to 10 volts and note the ammeter reading. It should be 14.5 to 16.5 amperes for all starting motors.

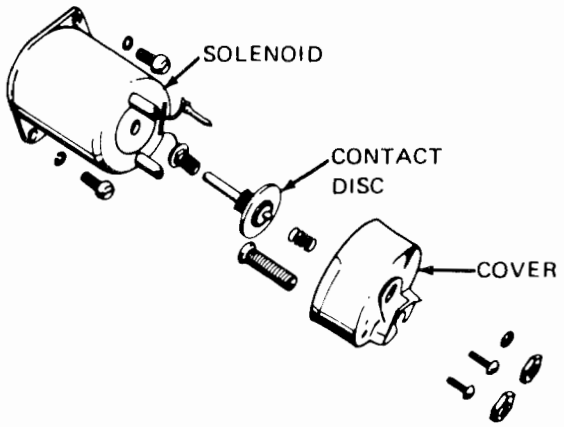
To check both windings, connect as for previous test. Ground the solenoid motor terminal. Adjust the voltage to 10 volts and note the ammeter reading. It should be 41 to 47 amperes for all starting motors.

NOTE: Current will decrease as windings heat up.

Current draw readings that are over specifications indicate shorted turns or a ground in the windings of the solenoid and the solenoid should be replaced. Current draw readings that are under specifications indicate excessive resistance. No reading indicates an open circuit. Check connections then replace solenoid if necessary.

Fig. 6D-47 -- Starter Unit Repair - 4 of 6

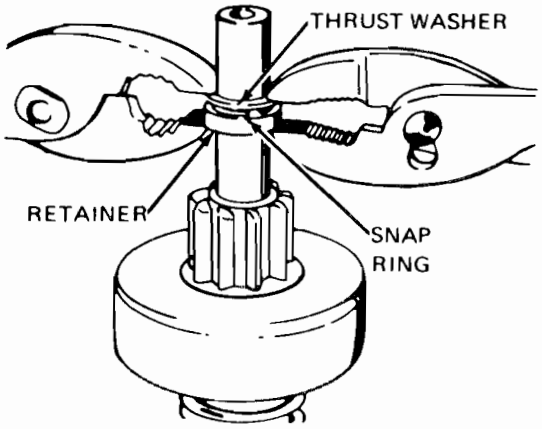
SOLENOID SWITCH DISASSEMBLY



f. The starter solenoid switch is serviced as an assembly. The cover can be removed to inspect the contacts and contact disc if necessary.

STARTER ASSEMBLY

INSTALLING RETAINER, WASHER AND RING



20. Assemble the armature and clutch as follows:
a. Lubricate drive end of armature shaft with lubricant 1960954 or equivalent.
b. Install center bearing (diesel starters) with bearing toward the armature winding. Then install the fiber washer on the armature shaft.
c. Slide clutch assembly onto armature shaft with pinion away from armature.
d. Slide retainer onto shaft with cupped side facing the end of shaft.
e. Install snap ring into groove on armature shaft.
f. Install thrust washer on shaft.
g. Position retainer and thrust washer with snap ring in between. Using two pliers, grip retainer and thrust washer or collar and squeeze until snap ring is forced into retainer and is held securely in groove in armature shaft.

21. Lubricate drive gear housing bushing with lubricant 1960954 or equivalent.

22. Engage shift lever yoke with clutch and slide complete assembly into drive gear housing.
On non-diesel starters the shift lever may be installed in drive gear housing first.

23. Install the center bearing screws (25 MT diesel only) and the shift lever pivot bolt. Tighten securely.

24. Install solenoid assembly.

25. Apply sealer, No. 1050026 or equivalent to solenoid flange where field frame contacts it.

26. Position field frame against drive gear housing on alignment pin using care to prevent damage to brushes.

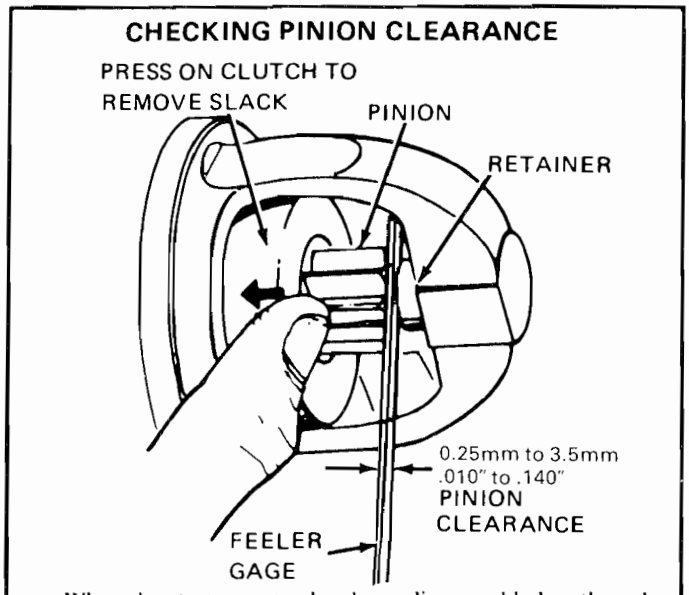
27. Lubricate commutator end-frame bushing with lubricant 1960954 or equivalent.

28. Install washer on armature shaft and slide end frame onto shaft, then install and tighten through-bolts. On diesel starter, install insulator and then end frame onto shaft. Then install through bolts, making sure they pass through bolt holes in insulator.

29. Connect the field coil connector to the solenoid terminal.

30. Check pinion clearance as outlined under PINION CLEARANCE.

Fig. 6D-48 -- Starter Unit Repair - 5 of 6



When the starter motor has been disassembled or the solenoid has been replaced, it is necessary to check the pinion clearance. Pinion clearance must be correct to prevent the buttons on the shift lever yoke from rubbing on the clutch collar during cranking.

31. Disconnect the motor field coil connector from the solenoid motor terminal and insulate it carefully.
32. Connect one 12 volt battery lead to the solenoid switch terminal and the other to the starter frame.
33. Flash a jumper lead momentarily from the solenoid motor terminal to the starter frame. This will shift the pinion into cranking position and it will remain so until the battery is disconnected.
34. Push the pinion back as far as possible to take up any movement, and check the clearance with a feeler gage. The clearance should be .010" to .140".

Means for adjusting pinion clearance is not provided on the starter motor. If the clearance does not fall within limits, check for improper installation and replace all worn parts.

Fig. 6D-49--Starter Unit Repair - 6 of 6

SPECIFICATIONS

BATTERY

MODEL NO.	APPLICATION	COLD CRANK RATE @ 0°F (-18°C)	AMPS FOR LOAD TEST	25 AMP. RESERVE CAPACITY (MINUTES)
(1981320) 70-500	350 V-8 (L98)	500	250	90

GENERATOR

MODEL NO.	APPLICATION	DELCO REMY SPEC. NO.	FIELD CURRENT AMPS 27 C (80°F) @ 12 VOLTS	RATED HOT OUTPUT** AMPS
1101127	350 V-8 (L98)	17SI 7216	4-4.5	105

**Ambient temperature 27°C. (80°F.).

STARTING MOTOR

MODEL NO.	APPLICATION	SPEC. NO.	FREE SPEED		
			VOLTS	AMPERES	RPM
1998527	350 V-8 (L98)	3563	10.6	70-110 (includes solenoid)	6500-10700

*Includes Solenoid

SECTION 6D3

CHARGING SYSTEM

CONTENTS

GENERAL DESCRIPTION 6D3-1
DIAGNOSIS 6D3-1
Undercharged Battery 6D3-1
Overcharged Battery 6D3-1
ON-VEHICLE SERVICE 6D3-2
UNIT REPAIR 6D3-4

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that component's section of the service manual. For complete Engine Electrical Diagnosis, refer to Section 8A, Electrical Diagnosis.

CHARGING SYSTEM-CS

This vehicle is equipped with the CS Charging System. Two sizes are available; CS-130 and CS-144, denoting the OD in mm of the stator laminations.

CS generators use a new type regulator, and a diode trio is not used. A delta stator, rectifier bridge, and rotor with slip rings and brushes are electrically similar to earlier generators. A conventional pulley and fan is used and, on the CS-130, an internal fan cools the slip ring end frame, rectifier bridge and regulator. The generator is connected internally as shown in Figure 6D3-1. Vehicle electrical connection to the generator is covered in Section 8A, Electrical Diagnosis.

Unlike three-wire generators, the CS-130 and CS-144 may be used with only two connections - battery positive and an "L" terminal to the charge indicator bulb. Use of "P", "F" and "S" terminals is optional. The "P" terminal is connected to the stator, and may be connected externally to a tachometer or other device. The "F" terminal is connected internally to fieldpositive, and may be used as a fault indicator. The "S" terminal may be connected externally to a voltage, such as battery voltage, to sense voltage to be controlled.

As on other charging systems, the charge indicator lights when the switch is closed, and goes out when the engine is running. If the charge indicator is on with the engine running, a charging system defect is indicated. For all kinds of defects, the indicator will glow at full brilliance, not "half lit". Also, the charge indicator will be on with the engine running if system voltage is too high or too low. The regulator voltage setting varies with temperature, and limits system voltage by controlling rotor field current.

This regulator switches rotor field current on and off at a fixed frequency of about 400 cycles per second. By varying the on-off time, correct average field current for proper system voltage control is obtained. At high speeds, the on-time may be 10% and the off-time, 90%. At low speeds, with high electrical loads, on-off time may be 90% and 10%, respectively.

No periodic maintenance on the generator is required.

DIAGNOSIS

CHARGING SYSTEM

Noise from a generator may be caused by a loose drive pulley, loose mounting bolts, worn or dirty bearings, defective diode or defective stator.

A basic wiring diagram showing lead connections is shown in Section 8A. To avoid damage to the electrical equipment, always observe the following precautions:

- Do not reverse connections to the generator.
- Do not short across or ground any of the terminals in the charging circuit, except as directed by the instructions.
- NEVER operate the generator with the output terminal disconnected.
- When connecting a charger or a booster battery to the car battery, see "Battery Charging", or "Jump Starting", Section 6D1.
- In some cars, a voltmeter may be used instead of an indicator lamp. Trouble in the charging system will show up as one or more of the following conditions:
  - A. Faulty indicator lamp operation.
  - B. An undercharged battery, as evidenced by slow cranking or hydrometer dark.
  - C. An overcharged battery, as evidenced by spewing of electrolyte from the vents.

CHARGING SYSTEM -CS

A basic wiring diagram for the CS charging system is shown in Figure 6D3-1. When operating normally, the indicator lamp will come on when the switch is turned on and go out when the engine starts. If the lamp operates abnormally, or if an undercharged or overcharged battery condition occurs, the following procedure may be used to diagnose the charging system. Remember that an undercharged battery is often caused by accessories being left on overnight, or by a defective switch which allows a lamp, such as a

trunk or glove box lamp, to stay on. Also, this generator does not have a test hole.

To diagnose the CS-130 and CS-144 charging systems, use the following procedure:

1. Visually check belt and wiring.
2. For vehicles without charge indicator lamp, go to Step 5.
3. With switch on, engine stopped, lamp should be on. If not, detach harness at generator, and ground "L" terminal.
   a. Lamp lights, replace generator.
   b. Lamp does not light, locate open circuit between grounding lead and ignition switch . Lamp may be open.
4. With switch on, engine running at moderate speed, lamp should be off. If not, detach wiring harness at generator.
   a. If lamp goes off, replace generator.
   b. If lamp stays on, check for grounded "L" terminal wire in harness.
5. Battery undercharged or overcharged.
   a. Detach wiring harness connector from generator.
   b. With switch on, engine not running, connect voltmeter from ground to "L" terminal.
   c. Zero reading indicates open circuit between terminal and battery. Correct as required.
   d. Reconnect harness connector to generator, run engine at moderate speed.
   e. Measure voltage across battery. If above 16V, replace generator.
   f. Turn on accessories, load battery with carbon pile to obtain maximum amperage. Maintain voltage at 13V or below.
      - If within 15 amperes of rated output, generator is OK.
      - If not within 15 amperes of rated output, replace generator.

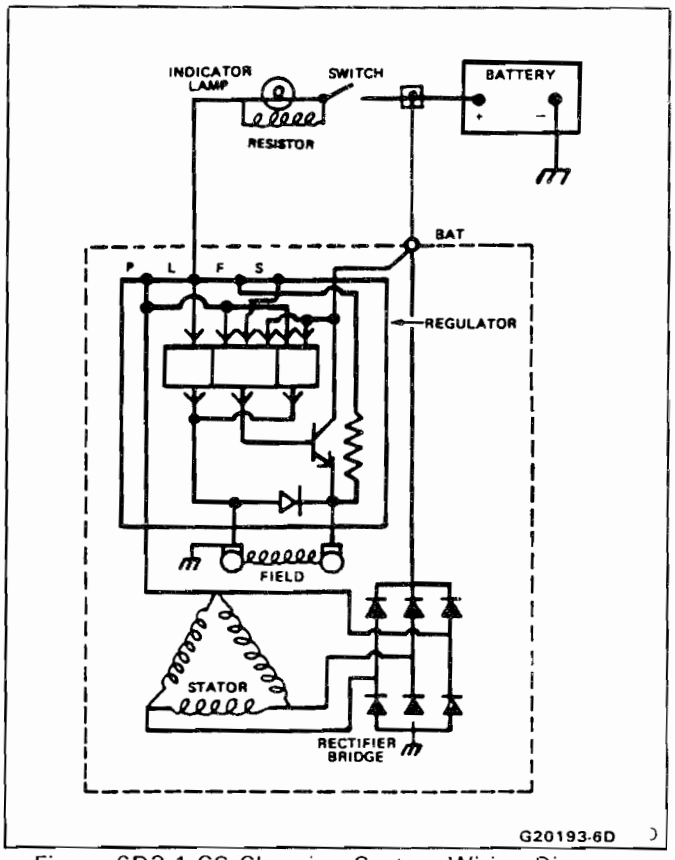


Figure 6D3-1 CS Charging System Wiring Diagram

SERVICE PROCEDURES

CHARGING SYSTEM

The generator does not require periodic lubrication. The rotor shaft is mounted on ball bearings at the drive end and roller bearings at the slip ring end. Each contains a permanent grease supply. At periodic intervals, check mounting bolts for tightness and adjust belt tension (see Section 6B).

Remove From Car

1. Disconnect negative battery cable at battery.
   CAUTION: Failure to observe this step may result in an injury from hot battery lead at generator.
2. Remove two terminal plug and battery leads on back of generator.
3. Loosen bolts.
4. Remove generator drive belt.
5. Remove thru bolts which retain generator.
6. Remove generator from car.

GENERATOR BENCH CHECK - CS

To check generator in a test stand, proceed as follows:

1. Make connections as shown in Figure 6D3-2, except leave the carbon pil disconnected. The ground polarity of generator an battery must be the same. The battery must be fully charged. Use a 30-500 OHM resistor between battery and "L" terminal.
2. Slowly increase generator speed and observe voltage.
3. If the voltage is uncontrolled and increase above 16.0 volts, the rotor field is shorted, the regulator is defective, or both. A shorted rotor field coil can cause the regulator to become defective. NOTE: The battery must be fully charged when making this test.

4. If voltage is below 16.0 volts, increase speed and adjust carbon pile to obtain maximum amperage output. Maintain voltage above 13.0 volts.

5. If output is within 15 amperes of rated output, generator is good.

6. If output is not within 15 amperes of rated output, generator is defective and requires replacement.

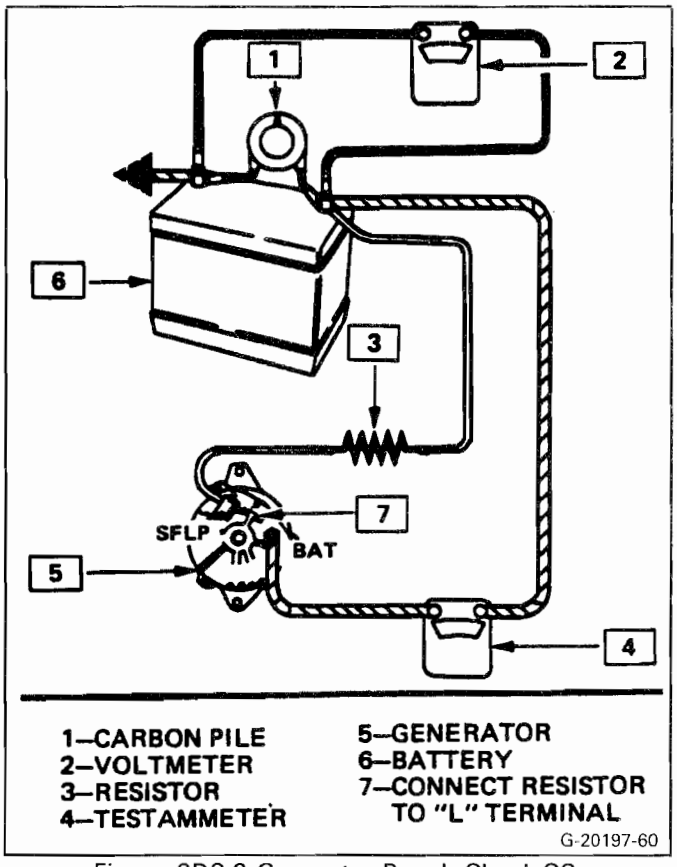


Figure 6D3-2 Generator Bench Check-CS

SECTION 6D4

IGNITION SYSTEM

CONTENTS

GENERAL DESCRIPTION 6D4-1
H.E.I. Distributor 6D4-1
Ignition Timing 6D4-1
Secondary Wiring 6D4-1
Spark Plugs 6D4-2
Ignition Switch 6D4-2
DIAGNOSIS 6D4-3
H.E.I. Distributor 6D4-3
Spark Plugs 6D4-3
ON-VEHICLE SERVICE 6D4-3
Set Ignition Timing 6D4-5
Remove and Replace 6D4-5
Distributor 6D4-5
Coil 6D4-6
Spark Plug Wires 6D4-6
Unit Repair 6D4-6

GENERAL DESCRIPTION

The ignition circuit consists of the battery, the distributor, the ignition switch, the spark plugs, and the primary and secondary wiring. Refer to the Battery portion of this section for battery information.

H.E.I. DISTRIBUTOR

Figure 6D4-1

The High Energy Ignition distributor with EST uses a magnetic pick-up assembly located inside the distributor which contains a permanent magnet, a pole piece with internal teeth, and pick-up coil. When the teeth of the timer core rotating inside the pole piece line up with the teeth of the pole piece, an induced voltage in the pick-up coil signals the electronic module to trigger the coil primary circuit. The primary current decreases and a high voltage is induced in the ignition coil secondary winding which is directed through the rotor and secondary leads to fire the spark plugs. The capacitor in the distributor is for radio noise supression.

All spark timing changkes in the H.E.I. (EST) distributor are done electronically by the Electronic Control Module (ECM) which monitors information from various engine sensors, computes the desired spark timing and signals the distributor to timing accordingly. No vacuum or mechanical advance are used. Further EST information is found in Section 6E2, Engine and Emission Controls.

Electronic Spark Control (ESC)

Electronic Spark Control (ESC) modifies (retards) the spark advance when detonation occurs. The retard mode is held for approximately 20 seconds after which the spark control will again revert to (EST). There are three basic components in the (ESC) system.

Further ESC information is found in Section 6E2, Engine and Emission Controls.

Sensor

The (ESC) sensor detects the presence (or absence) and intensity of detonation by the vibration characteristics of the engine. The output is an electrical signal that goes to the controller. A sensor failure would allow no retard.

DISTRIBUTOR

The Distributor is an HEI (EST) unit with an electronic module modified so it can respond to the (ESC) controller signal. This command is delayed when detonation is occurring, thus providing the level of retard required. The amount of retard is a function of the degree of detonation.

Controller

The (ESC) controller processes the sensor signal into a command signal to the distributor to adjust spark timing. The process is continuous so that the presence of detonation is monitored and controlled. The controller is a hard wired signal processor and amplifier which operates from 6 to 16 volts. Controller failure would be no ignition, no retard or full retard. The controller has no memory storage. Electrical Diagrams of this circuit are shown in Sections 8A, Electrical Diagnosis.

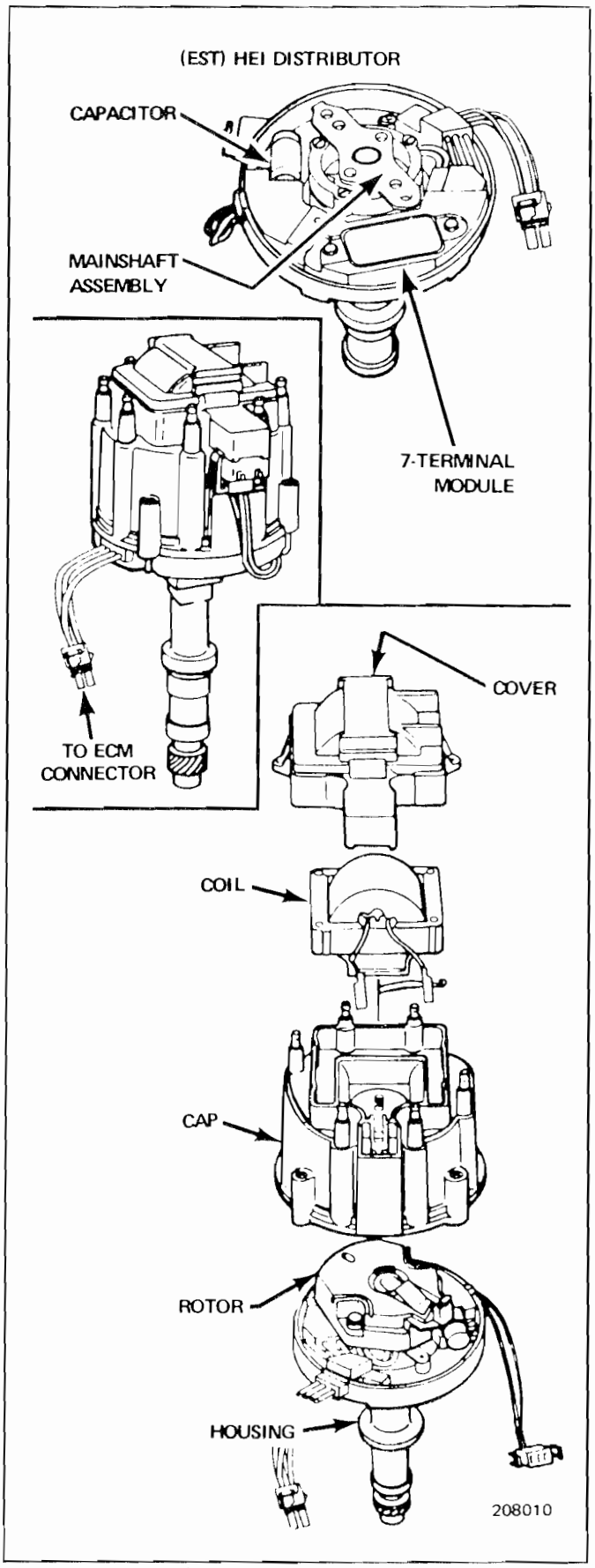
Ignition Timing

Timing specifications are listed on the Vehicle Emissions Control Information label in the engine compartment. **Always follow Vehicle Emission Control Information label procedures when adjusting timing.**

Some engines will incorporate a magnetic timing probe hole for use with special electronic timing equipment magnetic probe hole. Consult manufacturer's instructions for use of this equipment.

SECONDARY WIRING

The spark plug wiring used with the HEI system is a carbon impregnated cord conductor encased in an 8MM (5/16") diameter rubber jacket. The outer silicone jacket will withstand very high temperatures and also provide an excellent insulator for the higher voltage of the HEI system. The silicone spark plug boots form a tight seal on the plug and **the boot should be twisted 1/2 turn before removing.**



6D4-1 HEI Distributor

Care should be exercised in removing boots to avoid damage. Do not use pliers or other tools that could potentially cut and tear the silicone boot. Care should also be exercised when connecting any pick-up equipment. Do not force anything between the boot and wiring, or through the silicone jacket. Connections should be made in parallel using an adapter. DO NOT pull on the wire to remove. Pull on the boot, or use a tool designed for this purpose.

When replacing plug wires, route the wires correctly and through the proper retainers. Failure to rotate the wires properly can lead to radio ignition noise and crossfiring of the plugs, or shorting of the leads to ground. Spark plug wire routings are shown in the specified vehicle information subsections which follow later in this section.

SPARK PLUGS

Resistor type, tapered seat spark plugs are used (Figure 6D4-2). No gasket is used on tapered seat plugs. See Figure 6D4-3 for an explanation of letter coding on spark plugs.

Normal service is usually a mixture of idling, slow speed and high speed driving. Occasional high-speed driving is needed for good spark plug performance, because it gives increased combustion heat that burns away deposits of carbon or oxide that have built up from frequent idling or continual stop-and-go driving. Spark plugs are protected by an insulating nipple made of special heat-resistant material which covers the spark plug terminal and extends downward over a portion of the plug insulator. These nipples prevent flash-over, which causes missing, even though a dirt film is allowed to build up on the exposed portion of the plug.

Do not mistake corona discharge for flash-over or a shorted insulator. Corona is a steady blue light appearing around the insulator, just above the shell crimp. It is the visible evidence of a high-tension field, and has no effect on ignition performance. Usually it can be detected only in darkness. This discharge may repel dust particles, leaving a clear ring on the insulator just above the shell. This ring is sometimes mistakenly regarded as evidence that combustion gases have blown out between shell and insulator.

IGNITION SWITCH

The mechanical key-controlled switch is located in the steering column on the right hand side just below the steering wheel. The electrical switching portion of the assembly is separate from the key and lock cylinder and is located on top of the column. Both work together through the action of the actuator rod.

For a complete explanation of the key and lock cylinder, and the actuator rod, see STEERING, Section 3B. See Section 8A for the detailed explanation of the electrical switching.

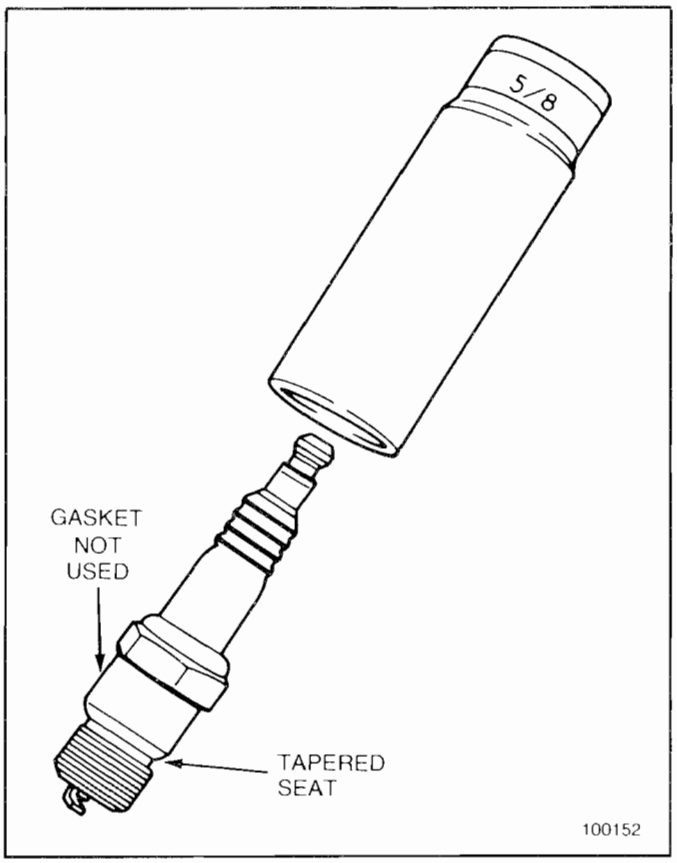


Figure 6D4-2 Spark Plug Tapered Seat

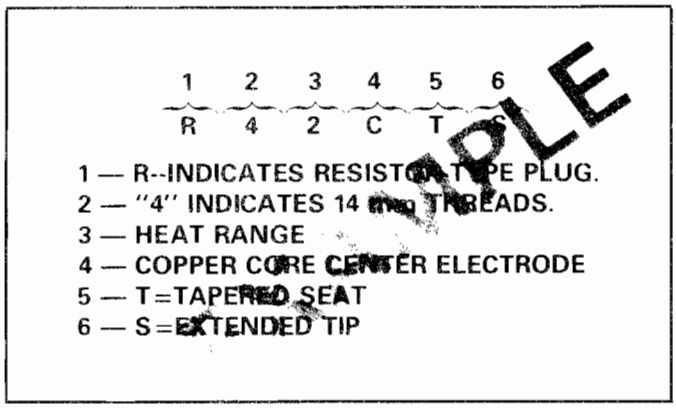


Figure 6D4-3 Spark Plug Coding.

DIAGNOSIS

H.E.I. DISTRIBUTOR

Refer to Section 6E, Engine and Emission Controls for HEI system diagnosis and EST and ESC diagnosis.

SPARK PLUGS

Worn or dirty plugs may work well at idling speed, but at higher speeds they frequently fail. Faulty plugs are indicated in a number of ways: poor fuel economy, power loss, loss of speed, hard starting and general poor engine performance.

Spark plugs may also fail due to carbon fouling, excessive gap, or a broken insulator.

Fouled plugs may be indicated by checking for black carbon deposits. The black deposits are usually the result of slow-speed driving where sufficient engine operating temperature is seldom reached. Worn pistons, rings, faulty ignition, over-rich carburetion and spark plugs which are too cold will also result in carbon deposits.

Excessive gap wear, on plugs of low mileage, shows that the engine is operating at high speeds or loads that are greater than normal or that a plug which is too hot is being used. Electrode wear may also be the result of plug overheating, caused by combustion gases leaking past the threads, due to insufficient torquing of the spark plug. Excessively lean carberation will also result in excessive electrode wear.

Broken insulators are usually the result of improper installation or carelessness when regapping the plug. Broken upper insulators usually result from a poor fitting wrench or an outside blow. The cracked insulator may not show up right away, but will as soon as oil or moisture penetrates the crack. The crack is usually just below the crimped part of shell and may not be visible.

Broken lower insulators usually result from carelessness when regapping and generally are visible. This type of break may also result from the plug operating too "hot", which may happen in periods of high-speed operation or under heavy loads. When regapping a spark plug, always make the gap adjustment by bending the ground (side) electrode. Spark plugs with broken insulators should always be replaced.

H.E.I. DISTRIBUTOR

Service Precautions

1. When making compression checks, disconnect the ignition switch feed wire. (Pink wire coming from the ignition coil.)
2. No periodic lubrication is required. Engine oil lubricates the lower bushing and an oil-filled reservoir provides lubrication for the upper bushing.

NOTICE: The tachometer terminal must NEVER be connected to ground, as damage to the module and/or ignition coil can result. An

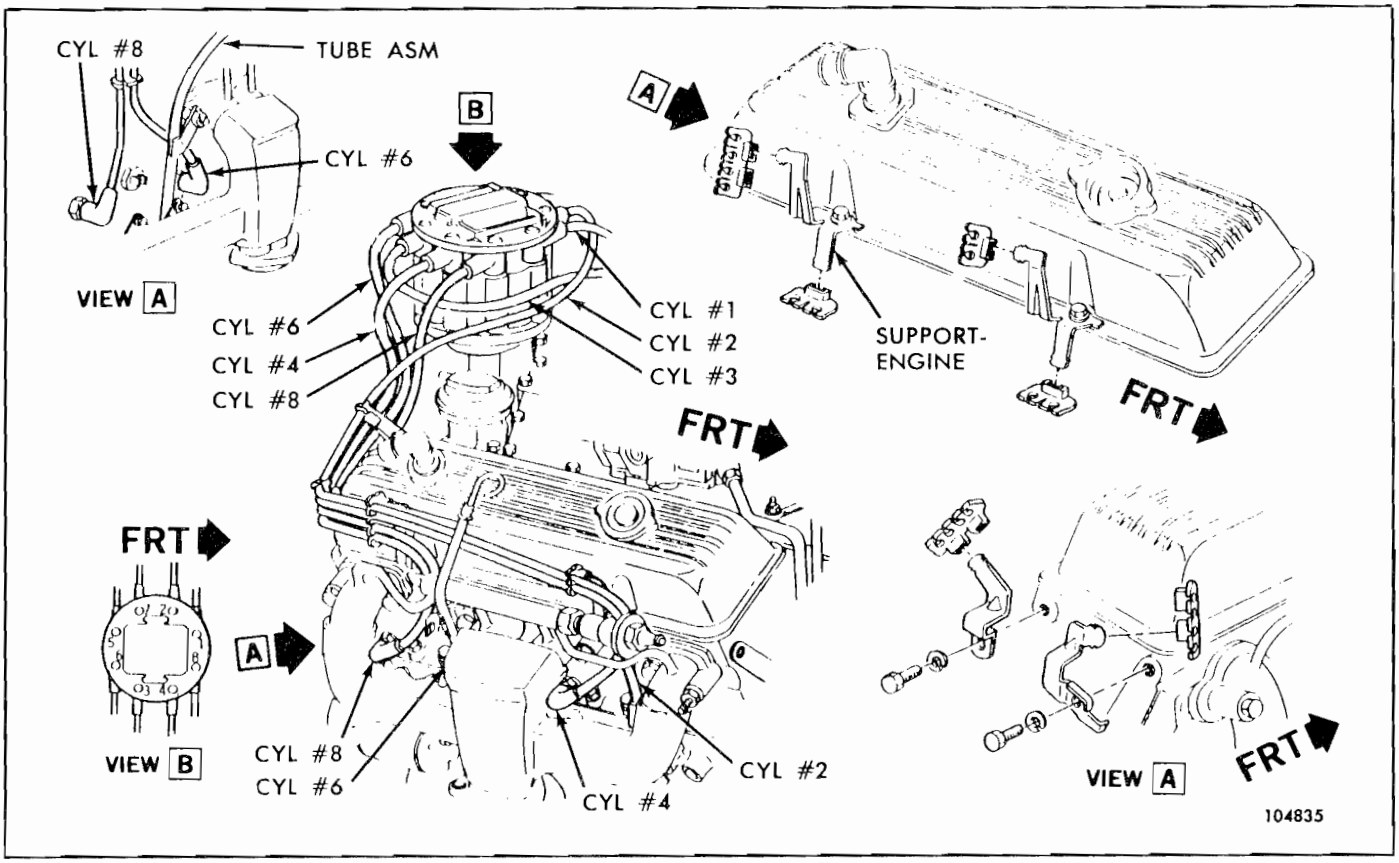


Figure 6D4-4 Spark Plug Wiring Routing R.H.

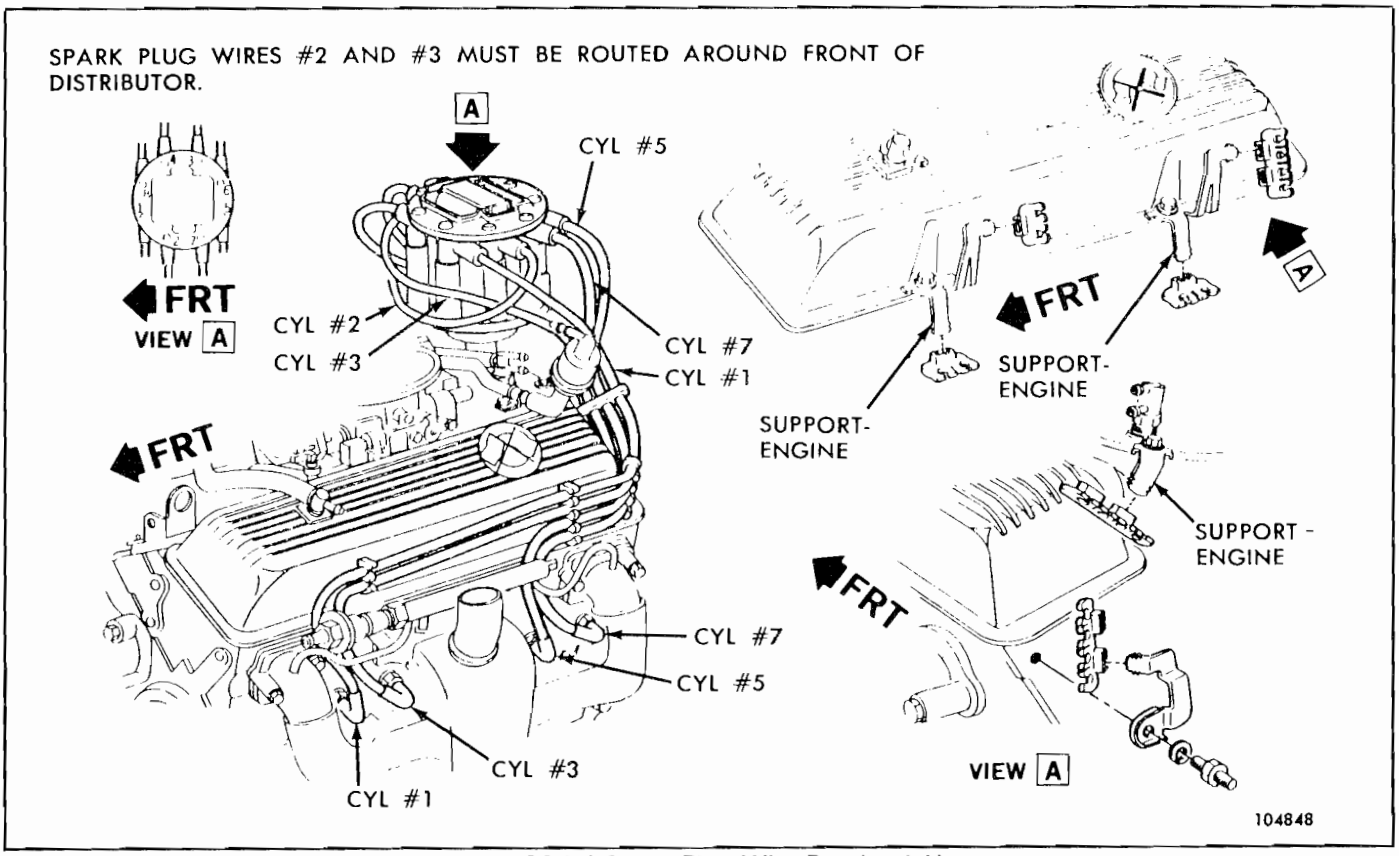


Figure 6D4-5 Spark Plug Wire Routing L.H.

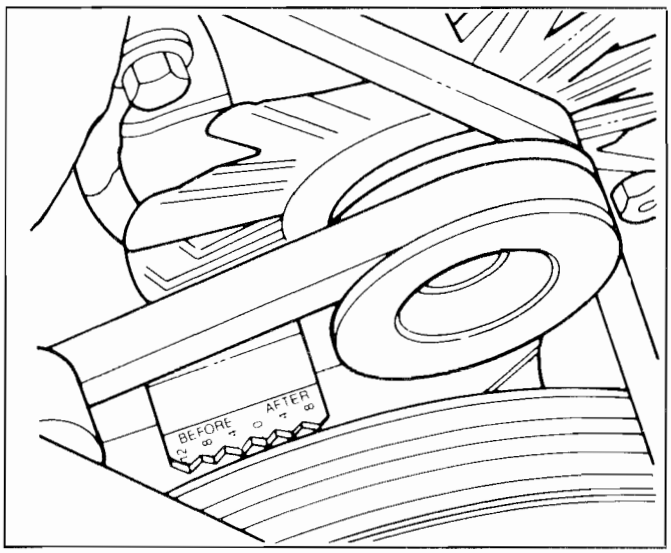


Figure 6D4-6 Timing Mark - Typical

immediate engine stall will occur if the tach lead is grounded.

Some tachometers currently in use may NOT be compatible with the High Energy Ignition System. Consult the manufacturer of the tachometer if questions arise.

4. Dwell adjustment is controlled by the module; and cannot be adjusted.
5. The material used to construct the spark plug cables is very soft. This cable will withstand more heat and carry a higher voltage, but scuffing and cutting become easier. The spark plug cables must be routed correctly to prevent chaffing or cutting. See Spark Plug Section of On-Car Service.

SET IGNITION TIMING

On vehicles with Electronic Spark Timing (EST), it will be necessary to disconnect the EST connector at the distributor to cause the engine to operate in the bypass timing mode.

1. Refer to the Vehicle Emissions Control Information label located on the radiator support panel. Follow all instructions on the label.
2. With ignition off, connect the pick-up lead of timing light to the number one spark plug. Use a jumper lead between the wire and plug or an inductive type pick-up. DO NOT pierce the wire or attempt to insert a wire between the boot and the wire. Connect the timing light power leads according to manufacturer's instructions.
3. Start the engine, and aim the timing light at the timing mark (see Figure 6D4-6). The line on the balancer or pulley will line up at the timing mark. If a change is necessary, loosen the distributor hold-down clamp bolt at the base of the distributor. While observing the mark with the timing light, slifhtly rotate the distributor until the line indicates the correct timing. Tighten the hold-down bolt, and re-check the timing.
4. Turn off the engine and remove the timing light. Reconnect the number one spark plug wire, if removed.

Distributor

Removal

1. Disconnect battery ground cable.
2. Remove air cleaner cover.
3. Remove distributor shield.
4. Disconnect ignition switch battery feed wire and tachometer lead (if equipped) from distributor cap. Also release the coil connectors from the cap. (DO NOT use a screwdriver or tool to release the locking tabs.)
5. Remove distributor cap by turning four latches counterclockwise. Move cap out of the way.
6. Disconnect four terminal ECM harness from distributor.
7. If necessary to remove secondary wires from cap, release wiring harness latches and remove wiring harness retainer. The spark plug wire numbers are indicated on the retainer.
8. Remove distributor clamp screw and hold-down clamp.
9. Note position of rotor, then pull distributor up until rotor just stops turning counterclockwise and again note position of rotor.

   To insure correct timing of the distributor, the distributor must be INSTALLED with the rotor correctly positioned as noted. If the engine was accidentally cranked after the distributor was removed, the following procedure can be used for installing:

   a. Remove No. 1 spark plug.
   b. Place finger over No. 1 spark. plug hole and crank engine slowly until compression is felt.
   c. Align timing mark on pulley to "O" on engine timing indicator.
   d. Turn rotor to point between No. 1 and No. 8 spark plug towers on distributor cap.
   e. Install distributor and connect ignition feed wire.
   f. Install distributor and connect ignition feed wire.
   g. Install distributor cap and spark plug wires.

Module

Removal

4. Do not wipe grease from module or distributor base if same module is to be replaced. If a new module is to be installed, a package of silicone grease will be included with it. Spread the grease on the metal face of the module and on the distributor base where the module seats. This grease is necessary for module cooling.

Installation

To install, reverse removal procedure.

Pick-Up Coil

Removal

1. Remove distributor from car and follow instructions in Figures 6D4-6 through 6D4-8.

Rotor

Removal

1. Remove distributor cap.
2. The rotor is retained by two screws and is provided with a slot which fits over a square lug on the advance weight base, so that the rotor can be installed in only on position.

Integral Ignition Coil

Removal

1. Remove distributor cap.
2. Remove three coil cover attaching screws, and lift off cover.
3. Remove coil attaching screws and lift ignition coil and lead from cap.

Installation

To install, reverse removal procedure.

Capacitor

The capacitor is part of the coil wire harness assembly. Since the capacitor is used only for radio noise suppression, it will seldom need replacement.

Removal

1. Remove distributor cap and rotor.
2. Remove capacitor attaching screw, and unplug connector from module. It may help to loosen the module.

Installation

1. To install, reverse above procedure.
2. Install hold down screw making sure ground lead is under screw.

SPARK PLUG WIRES

Use care when removing spark plug wire boots from spark plugs. Twist the boot 1/2 turn before removing, and pull on the **boot** to remove the wire.

When replacing plug wires, route the wires correctly and through the proper retainers. Failure to route the wires properly can lead to radio ignition noise and misfiring or shorting of the leads to ground.

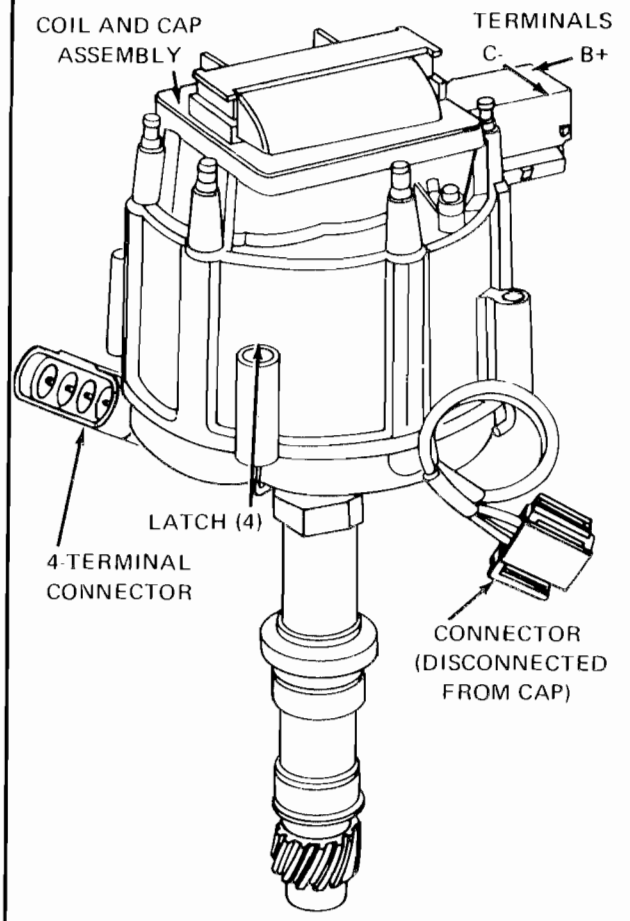
Special care should be exercised when reinstalling spark plug boots to assure that the metal terminal within the boot is fully seated on the spark plug terminal and that the boot has not moved on the wire. If boot to wire movement has occurred, the boot will give a false visual impression of being fully seated. A good check to assure that boots have been properly assumbled is to push sideways on the installed boots. If they have been correctly installed, a stiff boot, with only slight looseness will be noted. If the terminal has not been properly seated on the spark plug, only the resistance of the rubber boot will be flet when pushing sideways.

UNIT REPAIR

The following illustrated procedures are to be used when distributor out of vehicle repair is necessary.

DISTRIBUTOR DISASSEMBLY TEST AND REASSEMBLY

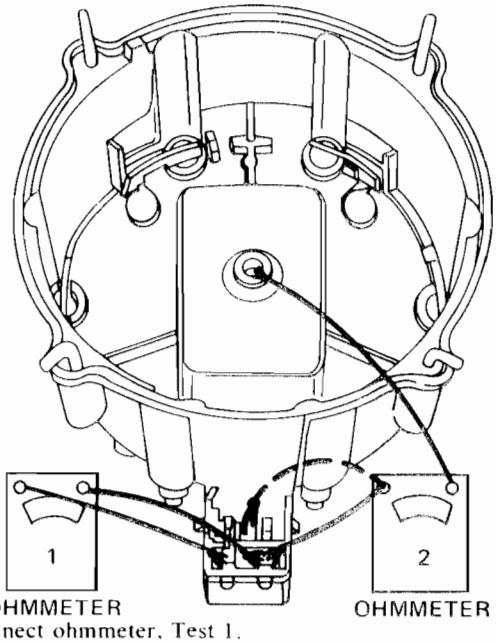
"COIL IN CAP" DISTRIBUTOR



1. A 6-cyl. EST distributor with coil-in-cap is illustrated.
2. Detach wiring connector from cap, as shown.
3. Turn four latches and remove cap and coil assembly from lower housing.

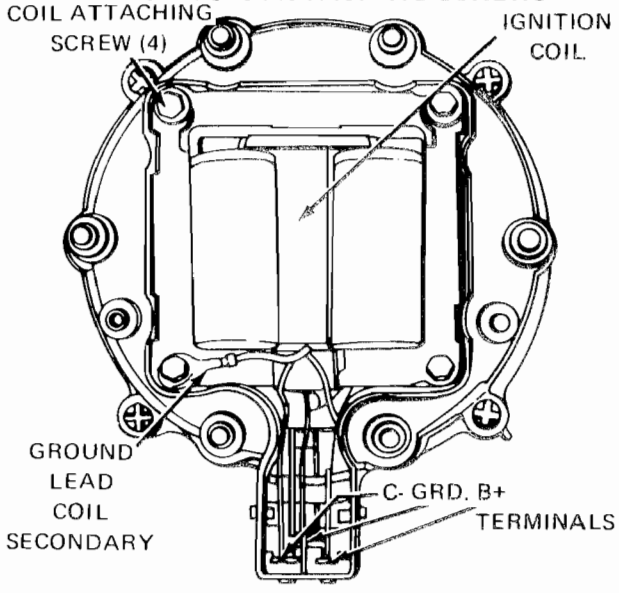
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TESTING IGNITION COIL



4. Connect ohmmeter, Test 1.
5. Reading should be zero, or nearly zero. If not, replace coil, Step 8.
6. Connect ohmmeter both ways, Test 2. Use high scale. Replace coil only if both readings are infinite, Step 8.
7. If coil is good, go to Step 13.

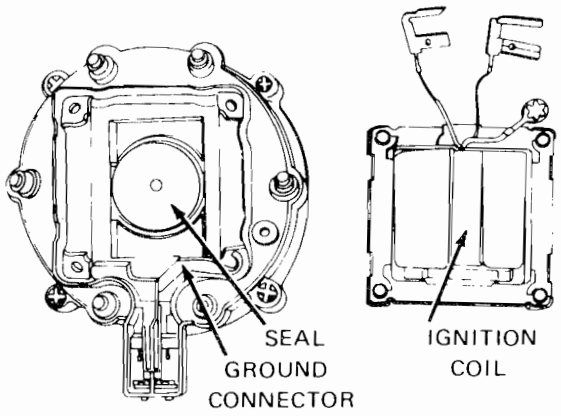
IGNITION COIL ATTACHING SCREWS



8. Remove coil-cover attaching screws and lift off cover.

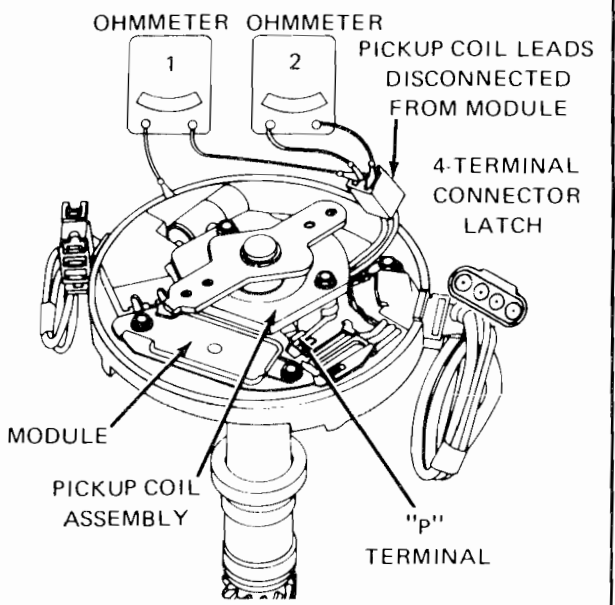
Figure 6D4-6 Unit Repair -Integral Coil 1 of 3

IGNITION COIL REMOVED FROM CAP



9. Remove ignition coil attaching screws and lift coil with leads from cap.
10. Remove ignition coil arc seal.
11. Clean with soft cloth and inspect cap for defects. Replace, if needed.
12. Assemble new coil and cover to cap.

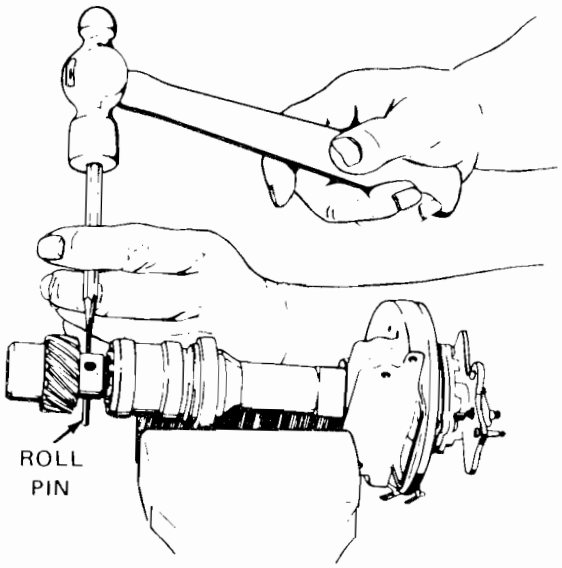
TESTING PICKUP COIL



13. On all distributors, including distributors with Hall Effect Switch identified in Step 27, remove rotor and pickup coil leads from module.
14. Connect ohmmeter Test 1 and then Test 2.
15. If vacuum unit is used, connect vacuum source to vacuum unit. Replace unit if inoperative. Observe ohmmeter throughout vacuum range; flex leads by hand without vacuum to check for intermittent opens.
16. Test 1 — should read infinite at all times.
Test 2 — should read steady at one value within 500-1500 ohm range.
NOTE: Ohmmeter may deflect if operating vacuum unit causes teeth to align. This is not a defect.
17. If pickup coil is defective, go to Step 18. If okay, go to Step 23.

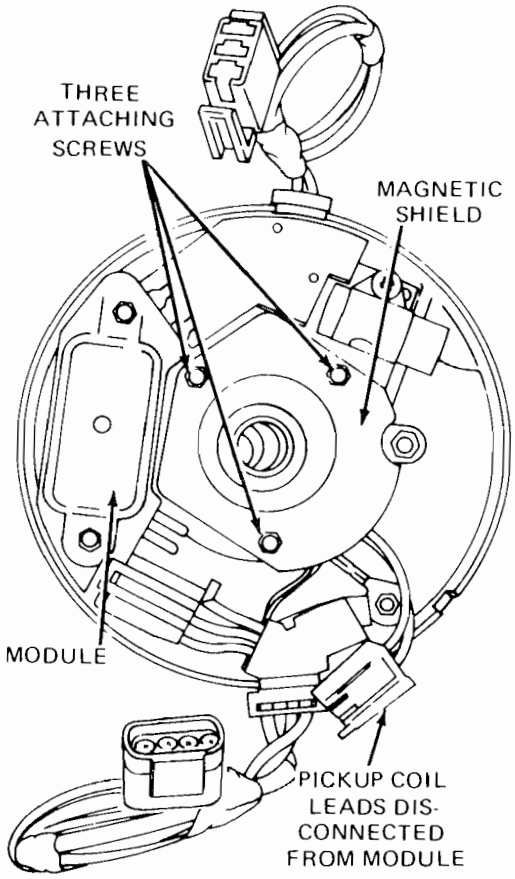
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DRIVING PIN FROM SHAFT



18. Mark distributor shaft and gear so they can be reassembled in same position.
19. Drive out roll pin.

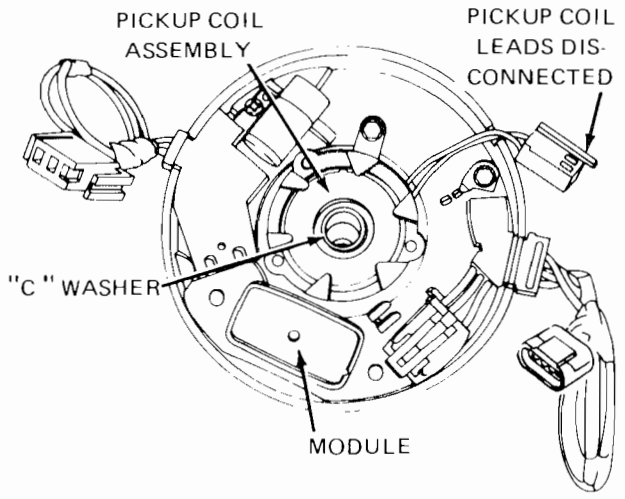
SHAFT ASSEMBLY REMOVED



20. Remove gear and pull shaft assembly from distributor.

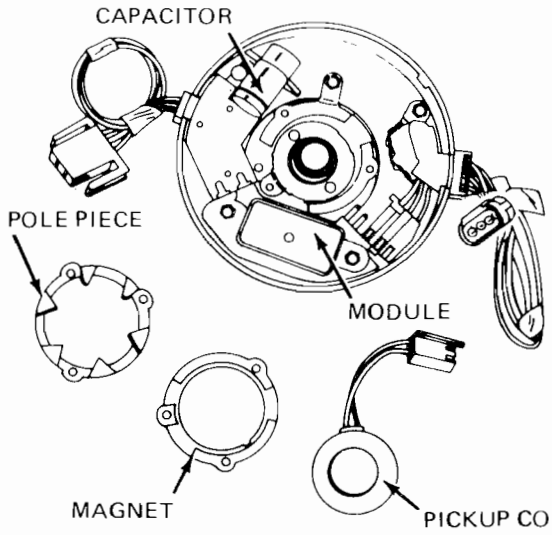
Figure 6D4-7 Unit Repair-Integral Coil 2 of 3

ALUMINUM NON-MAGNETIC SHIELD REMOVED



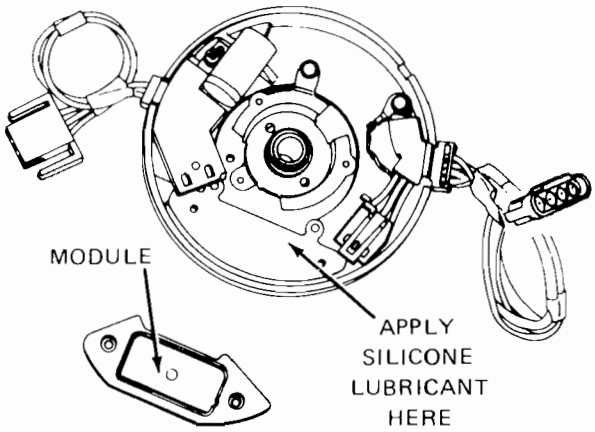
21. Remove three attaching screws and remove magnetic shield.

PICKUP COIL REMOVED AND DISASSEMBLED



22. Remove retaining ring and remove pickup coil, magnet and pole piece.

MODULE REMOVED

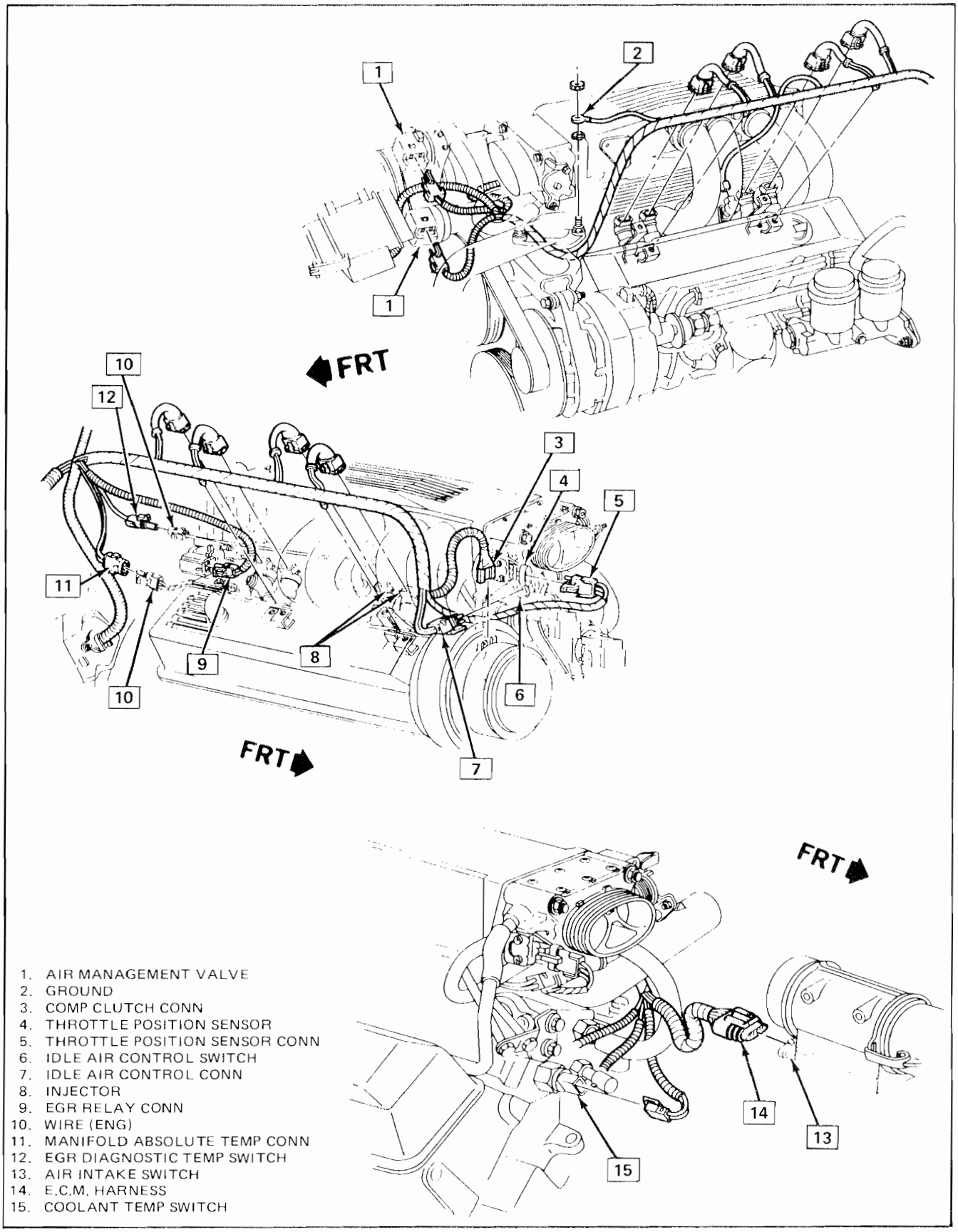


23. Remove two module attaching screws, and capacitor attaching screw. Lift module, capacitor and harness assembly from base.
24. Disconnect wiring harness from module.
25. Check module with an approved module tester.
26. Install module, wiring harness, and capacitor assembly. Use silicone lubricant on housing under module.

Figure 6D4-8 Unit Repair-Integral Coil 3 of 3

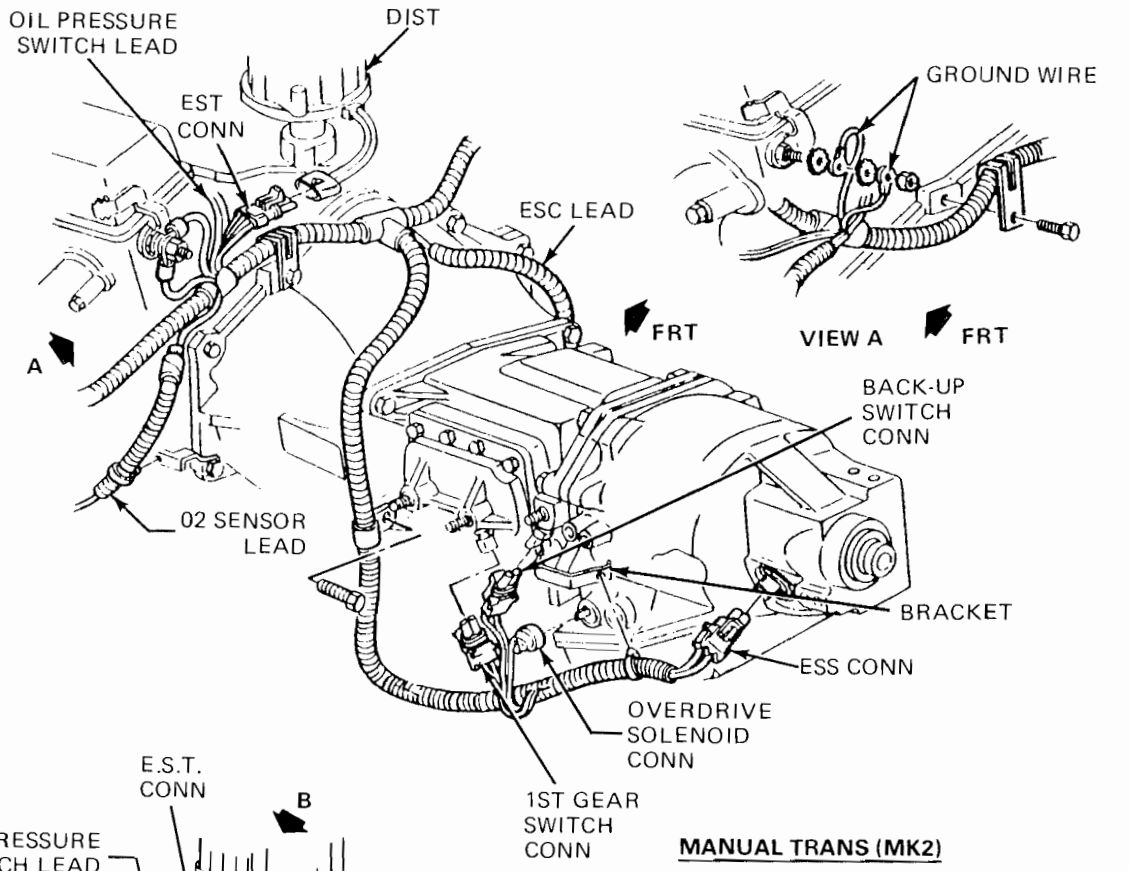
SECTION 6D5

ENGINE WIRING

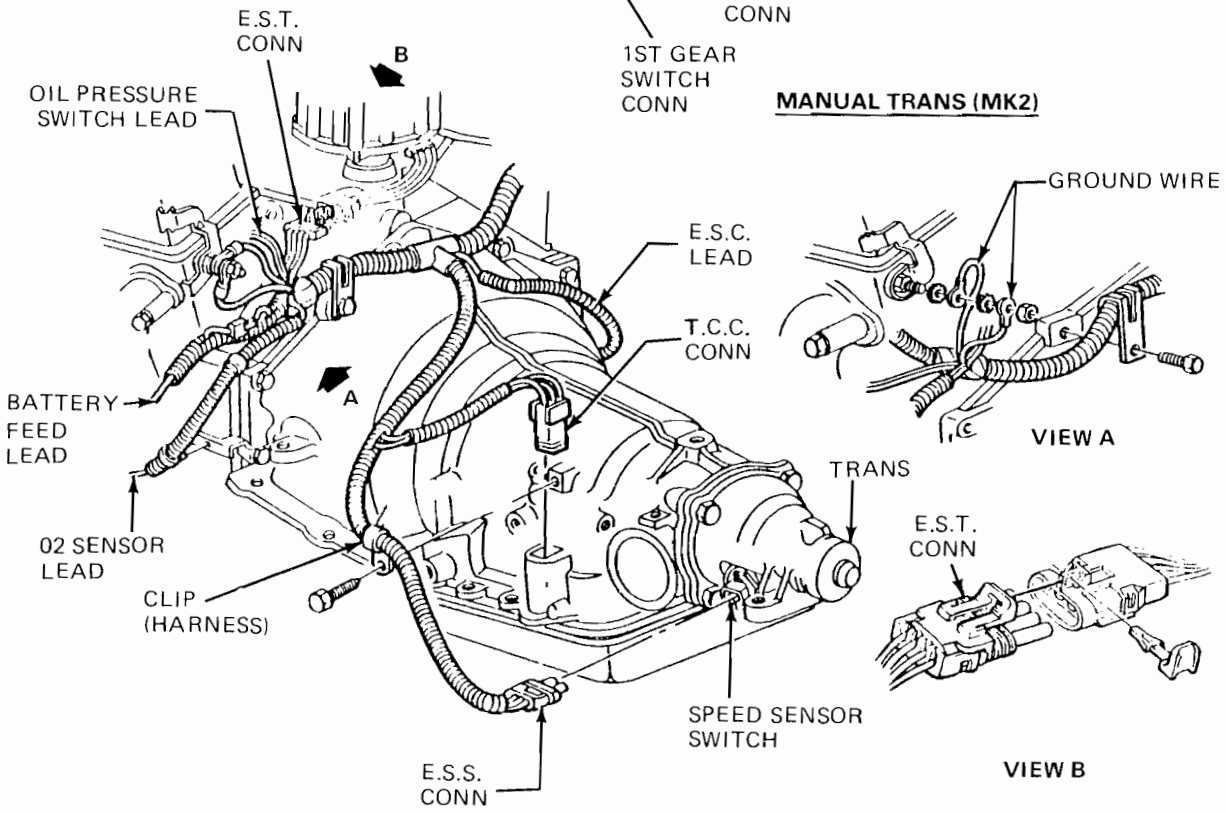


1. AIR MANAGEMENT VALVE
2. GROUND
3. COMP CLUTCH CONN
4. THROTTLE POSITION SENSOR
5. THROTTLE POSITION SENSOR CONN
6. IDLE AIR CONTROL SWITCH
7. IDLE AIR CONTROL CONN
8. INJECTOR
9. EGR RELAY CONN
10. WIRE (ENG)
11. MANIFOLD ABSOLUTE TEMP CONN
12. EGR DIAGNOSTIC TEMP SWITCH
13. AIR INTAKE SWITCH
14. E.C.M. HARNESS
15. COOLANT TEMP SWITCH

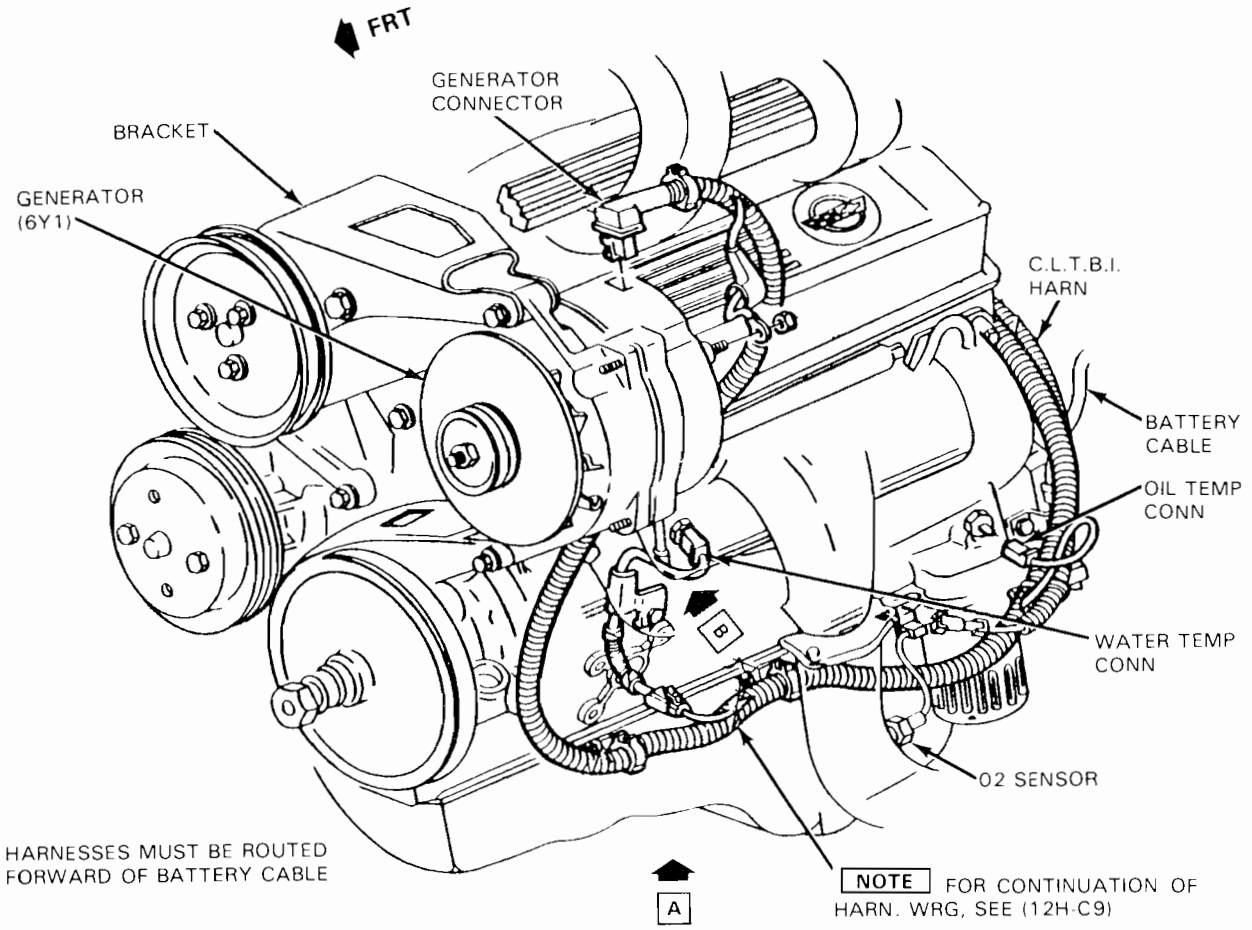
6D5-1 Trans. C.L. T.P.I. Harness L98

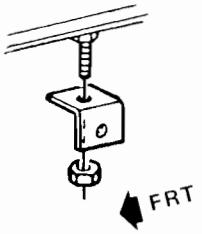


MANUAL TRANS (MK2)

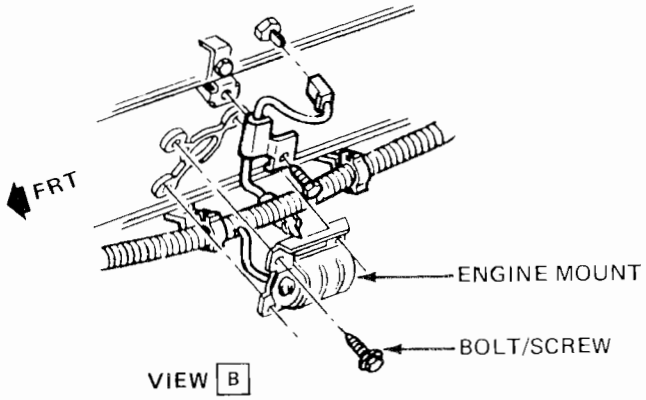


AUTO TRANS (NB1)



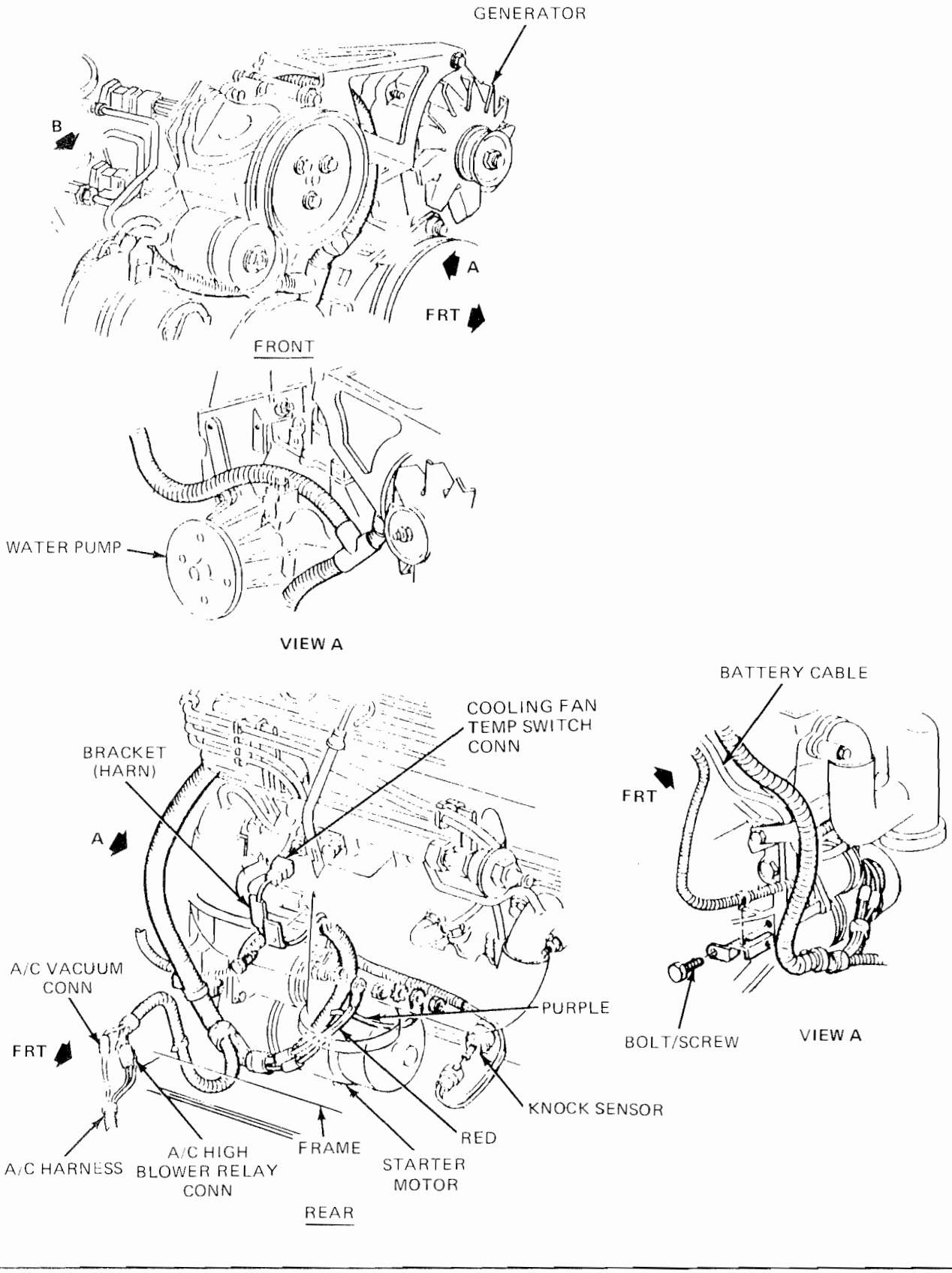


VIEW A

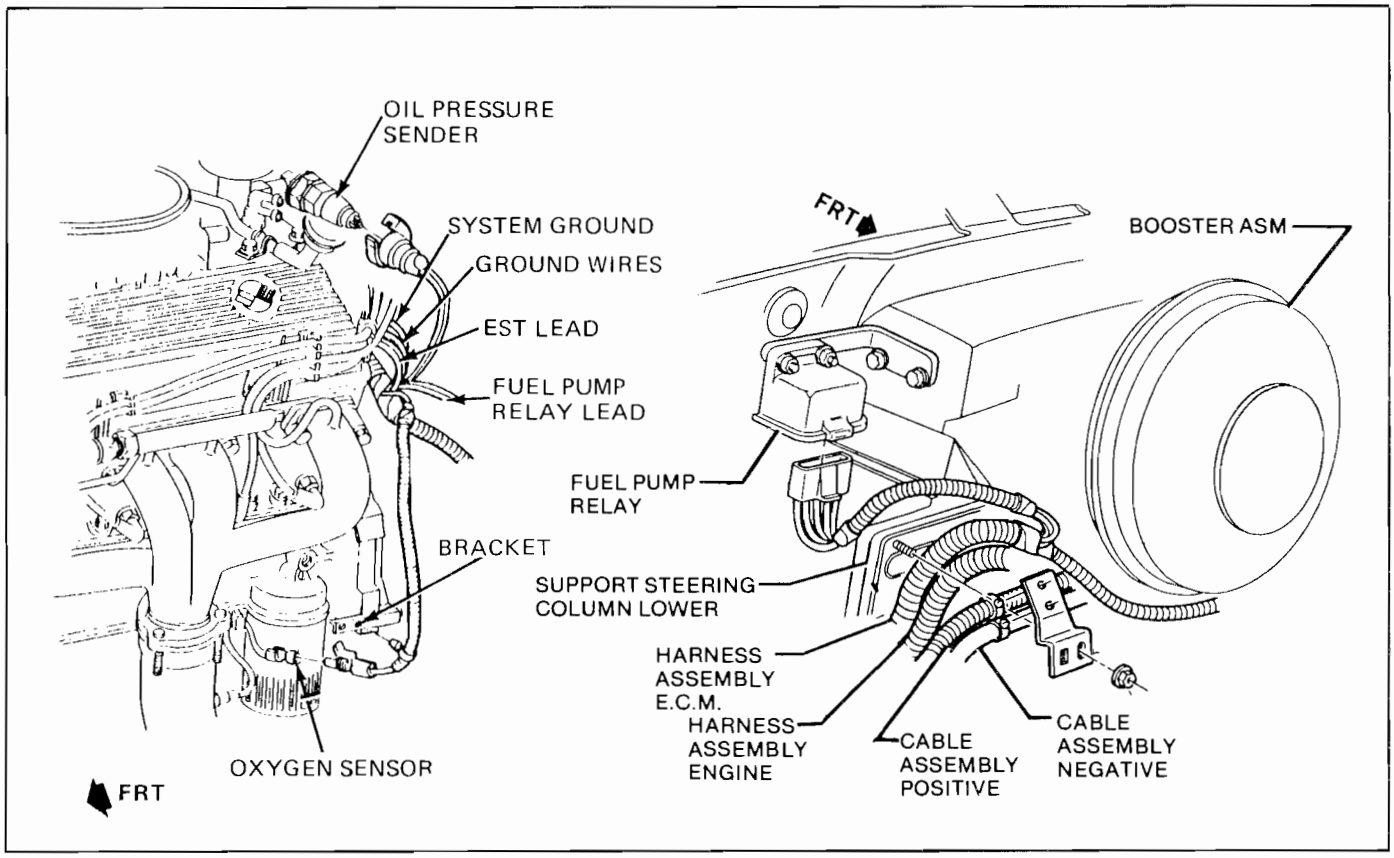


VIEW B

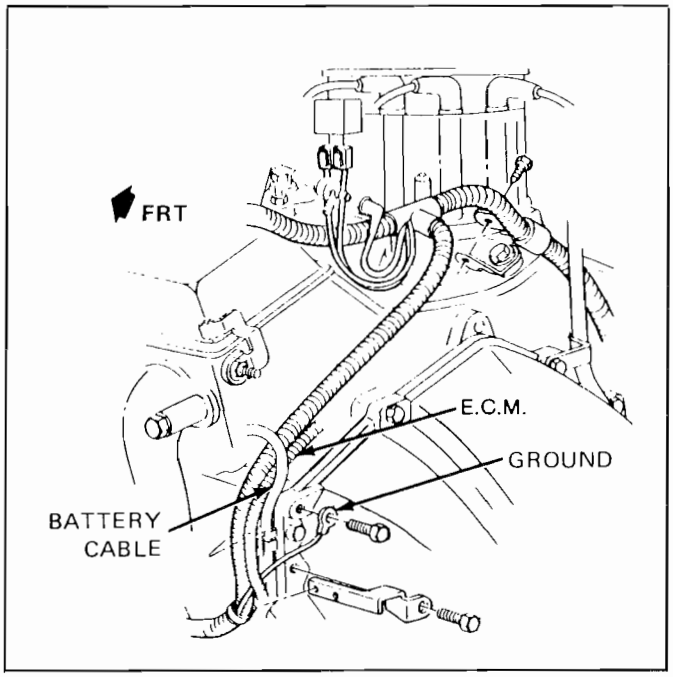
6D5-3 Engine Harness L.S. - L98



6D5-4 Engine Harness Front and Rear Views



6D5-5 C.L. T.P.I. Harn Plenum and Relay Wiring



6D5-6 Engine Harness L.H. Rr

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DRIVEABILITY AND EMISSIONS
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DRIVEABILITY

The driveability diagnosis procedures apply to various systems in current GM vehicles. The procedures assume that the vehicle worked right at one time and the problem is due to time, wear, dirt or other causes. Start with the introduction that follows. This will describe a systematic diagnostic procedure.

Any system disconnected during diagnosis should be reconnected. This includes wires, hoses, linkage, etc. When removing air cleaner, plug hose fittings that could cause an air leak.

EMISSIONS

The exhaust emission control systems used on General Motors engines perform a specific function to lower exhaust emissions while maintaining good fuel economy and driveability.

MAINTENANCE SCHEDULE

Refer to the General Motors Maintenance Schedule in Section 0B of the Chassis Service Manual for the maintenance service that should be performed to retain emission control performance.

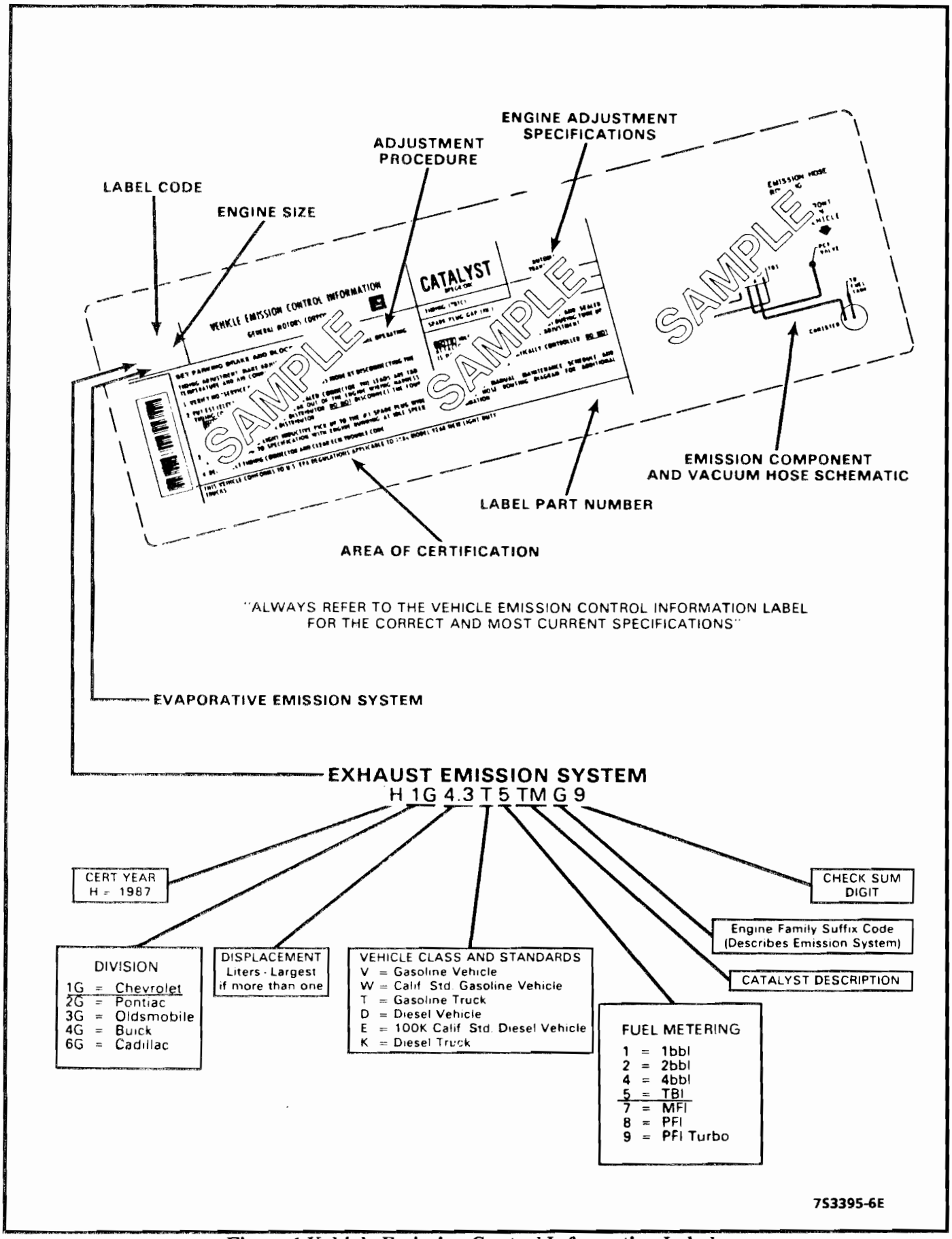


Figure 1 Vehicle Emission Control Information Label

VEHICLE EMISSION CONTROL INFORMATION LABEL

The Vehicle Emission Control Information label (Fig.1) contains important emission specifications and setting procedures. In the upper left corner is exhaust emission information which identifies the year, the manufacturing division of the engine, the displacement in liters of the engine, the class of vehicle and type of fuel metering. Also there is an illustrated emission component and vacuum hose schematic. This label is located in the engine compartment of every General Motors Corporation vehicle. If the label has been removed, it can be ordered from the parts division (WDDGM).

INTRODUCTION

Electronic Engine Control

All engines have an Electronic Control Module (ECM) to control the fuel system. The ECM varies the air/fuel ratio by controlling the fuel flow through the injector(s).

In addition, the ECM controls the ignition timing, fuel pump, and various other systems.

It is important to review the component sections and wiring diagrams in section 6E3 for a specific engine to determine what is controlled by the ECM and what systems are non-ECM controlled.

What this section contains

Each General Motors engine has system controls to reduce exhaust emissions while maintaining good driveability and fuel economy.

This Section explains:

- How to use the Driveability and Emission Section 6E3 for Port Fuel engines.
- A brief description of systems used to control fuel and emissions.
- Abbreviations that are used in Driveability and Emissions.
- Wiring harness service information for harnesses used with the ECM.
- Special tools used to diagnosis and repair a system.

Before checking the system, adhere to the following information:

Blocking Drive Wheels

The vehicle drive wheels should always be blocked, and Parking Brake firmly set, while checking the system.

Cold Oxygen Sensor

On some engines, the oxygen sensor will cool off after only a short period of operation at idle. This will put the system into "Open Loop. To restore "Closed Loop" operation, run the engine at part throttle and accelerate from idle to part throttle a few times until the system goes "Closed Loop".

VISUAL/PHYSICAL UNDERHOOD INSPECTION

One of the most important checks that must be done as part of any diagnostic procedure is a careful visual/physical underhood inspection. This can often lead to fixing a problem without further steps. Inspect all vacuum hoses for correct routing, pinches, cuts, or disconnects. Be sure to inspect hoses that are difficult to see beneath the air cleaner, compressor, generator, etc. Inspect all the wires in the engine compartment for correct and good connections, burned or chaffed spots, pinched wires, or contact with sharp edges or hot exhaust manifolds. This visual/physical inspection is very important. It must be done carefully and thoroughly.

ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

BASIC KNOWLEDGE REQUIRED

Before using this section of the Service Manual, there are some areas that you should be familiar with. Without this basic knowledge, you will have trouble using the diagnostic procedures contained in this section.

Basic Electric Circuits

You should understand the basic theory of electricity, and know the meaning of voltage, amps, and ohms. You should understand what happens in a circuit with an open or a shorted wire. You should be able to read and understand a wiring diagram. A short to ground is referred to as a ground to distinguish it from a short between wires.

Use of Circuit Testing Tools

You should know how to use a test light, how to connect and use a tachometer, and how to use jumper wires to by-pass components to test circuits. Care should be taken to not deform the terminal when testing.

Use of Digital Volt-Ohm Meter (DVOM)

You should be familiar with the Digital Volt-Ohm Meter, particularly essential tool J-29125-A,J34029A or equivalent. You should be able to measure voltage, resistance, and current and know how to use the meter correctly.

The Digital Volt-Ohm Meter is covered in the "Special Tools" portion of this section.

DIAGNOSTIC INFORMATION

The Electronic Control Module (ECM) is equipped with a self- diagnosis system which detects system failure and aids the technician by identifying the circuit at fault via a trouble code. Below is information about the way the ECM displays a problem and how this corresponds to a trouble code in the ECM. The ECM can also indicate an open or closed loop mode.

"SERVICE ENGINE SOON" Light

This light is on the instrument panel and has two functions:

- It is used to tell the driver that a problem has occurred, and that the vehicle should be taken for service as soon as reasonably possible.
- It is used by the technician to read out "Trouble Codes" to help diagnosis system problems.

As a bulb and system check, the light will come "ON" with the key "ON" and the engine not running. When the engine is started, the light will turn off. If the light remains on, the self-diagnostic system has detected a problem. If the problem goes away, the light will go out in most cases after 10 seconds, but a Trouble Code will remain stored in the ECM.

Intermittent "SERVICE ENGINE SOON" Light

The Diagnostic Charts in Section A are set up to check whether or not a stored trouble code is "intermittent" or "hard".

An "intermittent" code is one which does not reset itself, and is not present while you are working on the vehicle. The most probable cause for this is a loose connection. The facing page will contain diagnostic aids to help in detecting intermittents.

A "hard" code is one which is present when you are working on the vehicle and the condition still exists while working on the vehicle. The chart with the stored trouble code number will lead you to the cause of the problem.

Trouble Codes

The Electronic Control Module,(ECM), is really a computer. It uses sensors to look at many engine operating conditions. It has a memory and it knows what a certain sensor readings should be under certain conditions. These conditions are described on the facing page of each Trouble Code Chart. If a sensor reading is not what the ECM thinks it should be, the ECM will turn on the "SERVICE ENGINE SOON" light on the instrument panel, and will store a Trouble Code in the memory. The Trouble Code tells which CIRCUIT the trouble is in. A circuit consists of a sensor (such as coolant temperature), the wiring and connectors to it, and the ECM.

To get a Trouble Code out of the ECM, we use the Assembly Line Diagnostic Link (ALDL) connector.

ALDL Connector

The Assembly Line Diagnostic Link (ALDL) is a diagnostic connector located in the passenger compartment (Figure 2). It has terminals which are used in the assembly plant to check that the engine is operating properly before it leaves the plant. *Terminal "B" is the Diagnostic terminal, and it can be connected to terminal "A", or ground, to enter the Diagnostic mode, or the Field Service Mode.*

The ALDL Connector is also used by "SCAN" tools to read information from the ECM via the Serial Data Line. Serial Data information is used extensively throughout the manual.

Diagnostic Mode

If the Diagnostic terminal is grounded with the ignition "ON" and the engine stopped, the system will enter the Diagnostic Mode. In this mode the ECM will:

1. Display a code "12" by flashing the "SERVICE ENGINE SOON" light (indicating the system is operating). A code "12" consists of one flash, followed by a short pause, then two flashes in quick succession. This code will be flashed three times. If no other codes are stored, code 12 will continue to flash until the Diagnostic terminal is ungrounded.

Codes can only be obtained with the engine stopped. Grounding the Diagnostic terminal, with the engine running, gives the "field service mode" described below.

2. Display any stored trouble codes by flashing the "SERVICE ENGINE SOON" light. Each code will be flashed three times, then code "12" will be flashed again. If a trouble code is displayed, a Diagnostic Code Chart is to used to find the problem. The chart will determine if the problem exists (hard failure) , or is intermittent.

3. Energize all ECM controlled relays and solenoids except fuel Pump Relay.

4. The IAC valve also moves to the fully extended position.

Field Service Mode

If the Diagnostic terminal is grounded with the engine running, the system will enter the Field Service mode. In this mode, the "SERVICE ENGINE SOON" light will show whether the system is in Open or Closed Loop.

In Open Loop the "SERVICE ENGINE SOON" light flashes two and one-half times per second.

In "Closed Loop", the light flashes once per second: Also, in "Closed Loop", the light will stay OUT most of the time if the system is too lean. It will stay ON most of the time if the system is too rich.

While the system is in Field Service Mode, the ECM will be in the following mode:

1. New trouble codes cannot be stored in the ECM.

2. The closed loop timer is bypassed.

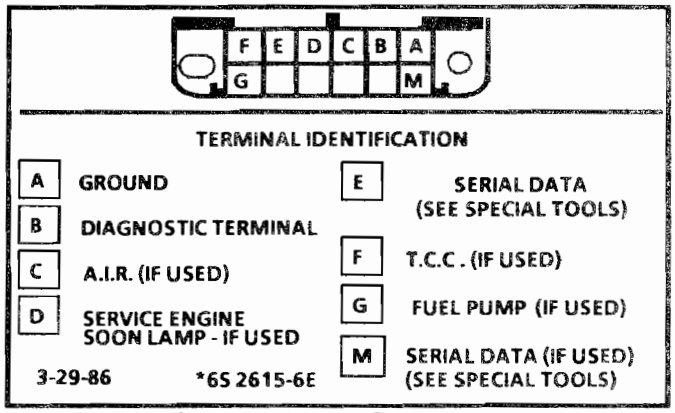


Figure 2 ALDL Connector

Clearing Trouble Codes

When the ECM sets a trouble code, the "SERVICE ENGINE SOON" light will come "ON" and a trouble code will be stored in memory. If the problem is intermittent, the light will go out after 10 seconds, when the fault goes away. However, the trouble code will stay in the ECM memory until the battery voltage to the ECM is removed. Removing battery voltage for 30 seconds will clear all stored trouble codes.

Trouble Codes should be cleared after repairs have been completed. Also, some Diagnostic Charts will tell you to clear the codes before using the chart. This allows the ECM to set the code while going thru the chart, which will help to find the cause of the problem more quickly.

NOTICE: To prevent ECM damage, the key must be "OFF" when disconnecting or reconnecting power to ECM (for example battery cable, ECM pigtail, ECM fuse, jumper cables. etc.).

ECM Learning Ability

The ECM has a "learning" ability which allows it to make corrections for minor variations in the fuel system to improve driveability. If the battery is disconnected to clear diagnostic codes, or for repair, the "learning" process has to begin all over again. A change may be noted in the vehicle's performance. To "teach" the vehicle, make sure the engine is at operating temperature, and drive at part throttle, with moderate acceleration and idle conditions, until normal performance returns.

DRIVEABILITY AND EMISSIONS SECTION 6E3 SUMMARY

The Driveability and Emissions Sections are subdivided into three sub sections:

SECTION A:STARTING POINT AND CODE CHARTS
- Diagnostic circuit check (Starting Point)
- No-start and fuel system check charts
- Code Charts

SECTION B: SYMPTOMS
Based on driveability symptoms, when no codes, or intermittent codes, are stored.

SECTION C: COMPONENT SYSTEMS
- Circuit descriptions
- On-car service
- Functional check/Diagnosis charts

SECTION "A"

Diagnostic Procedure Summary

This is the starting point for the diagnostic procedures. The diagnostic charts are related to the ECM and will determine if the ECM is working properly. This section diagnoses the fuel system controlled by the ECM and has charts to diagnosis a circuit when the ECM has displayed a trouble code.

The way to approach a problem is to follow three basic steps (shown in Figure 3):

1. **Are the On-Vehicle Diagnostics working?** We find this out by performing the **"Diagnostic Circuit Check". Since this is the starting point for the diagnostic procedure, always begin here.**

If the On-Vehicle Diagnostics aren't working, the "Diagnostic Circuit Check" will lead you to a chart in Section A to correct the problem. If the On-Vehicle Diagnostics are OK, the next step is:

2. **Is there a Trouble Code stored?** If a trouble code is stored, go directly to the numbered code chart in Section A. This will determine if the fault is still present. If no trouble code is stored, the third step is:

3. **"Scan" Serial Data.**
This involves reading the various piecies of information available on the Serial Data Stream with one of the tools available for that purpose. Information on these tools and the meaning of the various displays can be found in the succeeding paragraphs. Expected readings can be found on the facing page for the Diagnostic Circuit Check.

This procedure, which takes only a short time, will help lead you to repair the problem in the least amount of time.

ALDL "SCAN" TOOLS

The ALDL connector under the dash has a variety of information available on terminal "E". There are several tools on the market for reading this information.

"SCAN" tools do not make the use of diagnostic charts unnecessary. They do not tell exactly where a problem is in a given circuit. However, with an understanding of what each position on the equipment measures, and knowledge of the circuit involved, the tools can be very useful in getting information which would be more time consuming to get with other equipment.

In some cases, "SCAN" Tools will provide information that is either extremely difficult or impossible to get with other equipment.

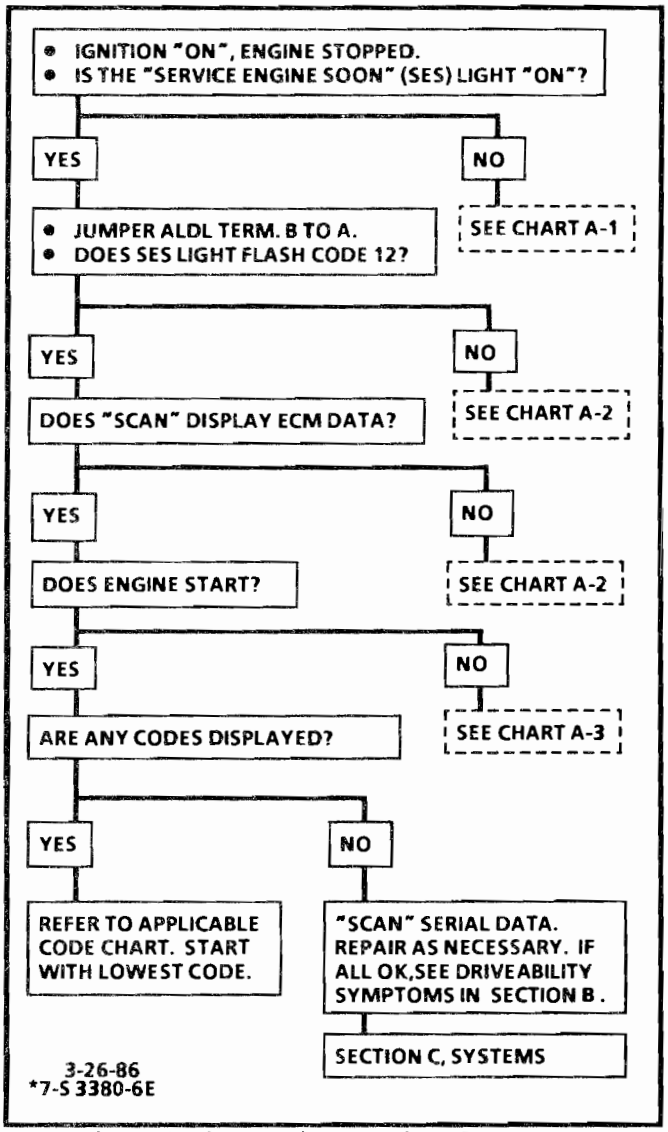


Figure 3 Diagnostic Procedure Summary

A "SCAN" TOOL THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED AND THE PROBLEM SHOULD BE REPORTED TO THE MANUFACTURER. THE USE OF A FAULTY "SCAN" TOOL CAN RESULT IN MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

Trouble Tree Charts incorporate diagnosis procedures using an ALDL "SCAN" tool where possible.

Some ECMs have three modes for transmitting information but some only read data in the open mode. The following information will describe each of the three modes where applicable and the affects they may cause.

Normal (Open) Mode

Not all engines and ECM families will transmit information on the Serial Data Line while in this mode.

The 5.7L can be monitored in the open mode, it allows certain parameters to be obtained without changing the engine operating characteristics.

ALDL (10K ,or Special) Mode

In this mode, on the 5.7L, there are less parameters that can be monitored and the data update rate is slower. Update rate is about every 1.5 seconds. Also, in this mode, the following operating characteristics will be modified.

- Closed loop timers are bypassed
- EST (spark) is advanced
- IAC will control engine idle to 1000 rpm ± 50 RPM.
- On some engines, canister purge solenoid will be enabled
- P/N restricted functions will be disabled

Factory Test (Back-up or 3.9 K) Mode

When in this mode, the ECM is operating on the fuel back-up logic and calibrated by the Calpak. The Calpak is used to control the fuel delivery if the ECM fails. This mode verifies that the back-up feature is OK. The parameters that can be read on a "SCAN" tool in this mode are not of much use for service.

"SCAN" TOOL LIMITATIONS AND USE

The "SCAN" tool allows a quick check of sensors and switches which are inputs to the ECM. However, on some applications the data update rate makes the tool not as effective as a voltmeter when trying to detect an intermittent which lasts for a very short time. However, the "SCAN" tool allows one to manipulate wiring harnesses or components under the hood while observing the "SCAN" readout. This helps in locating intermittents with the engine not running.

Intermittent Conditions

The "SCAN" tool is helpful in cases of intermittent operation. The tool can be plugged in and observed while driving the vehicle under the condition where the light comes "ON" momentarily, or the engine driveability is poor momentarily. If the problem seems to be related to certain areas that can be checked on the "SCAN" tool, then those are the positions that should be checked while driving the vehicle. If there does not seem to be any correlation between the problem and any specific circuit, the "SCAN" tool can be checked on each position, watching for a period of time to see if there is any change in the readings that indicates intermittent operation.

The "SCAN" tool is also a useful and quick way of comparing operating parameters of a poorly operating engine with a known good one. For example; A sensor may shift in value but not set a code. Comparing with a known good vehicle may uncover the problem.

The "SCAN" tool has the ability to save time in diagnosis and prevent the replacement of good parts. The key to using the "SCAN" tool successfully for diagnosis lies in the technicians ability to understand the system he is trying to diagnose as well as an understanding of the "SCAN" tool's limitations. Therefore, the technician should read the tool operating manual to become familiar with the tool. The following information will describe most of the "SCAN" tool positions and how they can be helpful in diagnosis.

"SCAN" TOOL POSITIONS

Mode

Check with the "Scan" tool manufacture to determine what the function of this mode is. In most cases it allows the user to place the ECM in different operating modes.

Injector Pulse Width

In this position, the reading is given in milliseconds which is the on time that the ECM is commanding to the injector(s).

Closed Loop/Open Loop

This position will indicate whether the engine control system is operating in open or closed loop. Most systems go closed loop after a certain amount of run time, when coolant temperature is high enough, and the oxygen sensor becomes active.

Trouble Codes

Will display any trouble codes stored in the ECM memory.

TPS (Throttle Position Sensor)

Values read will be the voltage as seen by the ECM. The voltage should be the TPS specification with the throttle closed and go up to about 5 volts with throttle wide open (WOT).

Oxygen

The reading will be read out in millivolts (mv) with a range from 1 to 999 mv. If the reading is consistently below 350 (350 mv), the fuel system is running lean as seen by the ECM and if the reading is consistently above 550 (550 mv), the system is running rich.

PROM ID

In this position, information is used for assembly verification only. PROM ID is useful only when the vehicle is equipped with the original ECM and Mem-Cal.

RPM

Displays engine RPM. Often useful if extra reference pulses are suspected. A sudden high RPM indication while at a steady throttle would indicate electrical interference (EMI) in the reference circuit. This interference is usually caused by ECM wires too close to ignition secondary wires or an open distributor ground circuit.

MPH

Displays vehicle speed. Useful in Checking TCC lock up speed or speedometer accuracy.

MAF

Displays the amount of air passing the MASS AIRFLOW SENSOR (MAF) in grams per second. Useful when comparing the airflow between a problem vehicle and a known good one. Normal readings at idle are about 4 to 8 grams. If a code 33 0r 34 is set, this reading will display the ECM default value.

Airflow

This display should be the same as MAF when no failures in the MAF sensor circuit exist. When a code 33 or 34 is set however, this value will not move and will indicate the gm/sec that the failure has detected.

Coolant Temperature

Displays engine temperature in degrees centigrade. After engine is started the temperature should rise steadily to about 85-95° C then stabilize when the thermostat opens.

Manifold Air Temperature (MAT) Sensor

Displays temperature of the intake manifold air. Should read close to ambient air temperature when the engine is cold, and rise as underhood and engine temperature increases.

Park/Neutral Switch

The indication in this mode may vary with manufacturer so the type of reading for a particular tool should be checked in the operators manual. The important thing is that the the reading changes state (switches) when the gear selector is moved from park /neutral to drive or reverse.

Torque Convertor Clutch (TCC)

In this position, the tool will indicate when the TCC has been commanded by the ECM to turn on. This does not necessarily mean that the clutch was engaged but only that the ECM grounded the circuit internally. The best way to determine if the clutch has engaged is to monitor engine RPM when the TCC comes "on".

EGR (Duty Cycle)

The EGR system uses a valve to feed a small amount of exhaust gas back into the intake manifold to control formation of NOx. Like all ECM outputs the "SCAN" tool only indicates that the ECM has commanded the function and does not indicate that the function has really happened.

Integrator and Block Learn

On Fuel Injected Engines, normal readings for these positions are around 128, if higher, it indicates that the ECM is adding fuel to the base fuel calculation because the system is lean, and if the numbers are below 128 the ECM is taking out fuel from the base calculation because the system is rich. The integrator is short term corrective action while the block learn portion (which is a long term correction) will only change if the integrator has seen a condition which lasts for a calibrated period of time.

EGR Diagnostic

Displays state of the EGR diagnostic switch.

Block Learn Memory (BLM) Cell

There are from two to sixteen different cells which the ECM learns at depending on RPM and airflow or MAP. This parameter will display what cell the ECM is using for the fuel calculation at the time.

IAC (Idle Air Control)

This system is used to control engine idle speed to the desired RPM, for different operating conditions. In this mode, the numbers will indicate what position the ECM thinks the valve is in. The ECM moves the IAC in counts and these counts are are what is displayed on a "SCAN" tool.

Desired RPM

Indicates the RPM to which the ECM is trying to control the idle.

Shift Light

Displays "yes", when the ECM is commanding the shift light to turn "on".

PPSW

This is the voltage on the fuel pump feed circuit.

A/C Request

Displays the state of the A/C signal line to the ECM. Should read " yes" whenever the A/C is requested.

Spark Advance

Displays number of degrees of advance from the base advance.

LV8 (Load Variable)

This position displays the load being put on the engine as calculated by the ECM, using RPM and air flow.

Knock Retard

Indicates the number of degrees the ECM is retarding the Electronic Spark Timing.

Knock Signal

Displays a "yes" when knock is detected by the ECM and displays a "no" when knock is not detected.

AD Bat

Displays the battery voltage detected at the ECM ignition input.

Fan

Displays "on" when the cooling fan has been commanded "on".

CCP

Displays "on", when the Canister Purge Solenoid is commanding purge. Some display Duty Cycle from 0-100%.

Overdrive Switch (A.T.)

Displays the state of the overdrive switch.

Overdrive Switch (M.T.)

Displays the state of the overdrive request switch.

1st Gear Switch (M.T.)

Displays the state of the manual transmission 1st gear switch.

4th gear

Displays state of the 4th gear switch. Yes = 4th gear.

Fan Request

Displays the state of the A/C Fan Control Switch. Should read "yes" when fan is requested.

SECTION B - DRIVEABILITY SYMPTOMS

Always start with Section A "Diagnostic Circuit Check" before proceeding to the driveability symptoms. Section A checks the ECM, which may cause the driveability problem. A definition of each symptom is included. This will then lead to the most probable causes of the driveability problem.

SECTION C - COMPONENT SYSTEMS

There are many component systems that are used to control fuel and emissions. Section C introduces each component system or control with a general description, diagnosis, and on- vehicle service.

Each of the Section C diagnosis sections will contain information on how the "Scan" tool can be used for diagnosing a particular component when a trouble code has not been set. (example: Section C-1 under diagnosis will explain how the "Scan tool" can be used for diagnosis as well as what the normal readings would be for the ECM Sensors.

Electronic Control Module (ECM)

This Section describes the ECM and the information sensors in the system. Figure 4 shows the operating conditions which the ECM may sense and the systems that the ECM may control (see specific engines to determine which are applicable to that engine).

Fuel Control System

The ECM controls the air/fuel delivery to the combustion chamber by controlling the fuel flow through the injector(s).

Electric Fuel Pump (in-tank)

The in-tank fuel pump is controlled by the ECM. When ignition is turned on, the pump will run for 2 seconds, then stop unless the engine is cranking or running.

Evaporative Emission Control

This system has a canister which stores fuel vapor from the fuel tank. The fuel vapor is removed from the canister and consumed in the normal combustion process when the engine is running. This system is used on all engines and may or may not be controlled by the ECM.

Electronic Spark Timing (EST)

This system is controlled by the ECM which controls spark advance (timing) and is used on all engines.

Electronic Spark Control (ESC)

This system uses a Knock Sensor in connection with the ECM to control spark timing to allow the engine to have maximum spark advance without spark knock. This improves driveability and fuel economy.

Air Injection Reaction (AIR)

The system provides additional oxygen to the exhaust gases to continue the combustion process. The system also supplies additional air to the catalytic converter under certain conditions. The A.I.R. system is not on all engines.

Exhaust Gas Recirculation (EGR)

The EGR system uses a valve to feed a small amount of exhaust gas back into the intake manifold to control formation of NOx.

Transmission Converter Clutch (TCC)

The TCC is ECM controlled and is used on all engines with an automatic transmission. This system reduces slippage losses in the torque convertor by coupling the engine flywheel to the output shaft of the transmission.

Shift Light Control

The ECM controls the shift light on some manual transmission vehicles to indicate the best shift point for maximum fuel economy. This control is not on all applications.

A/C Clutch Control

The ECM may control the A/C clutch on the compressor to improve idle quality. This control is not on all engines.

Electric Cooling Fan Control

Under certain conditions, the ECM may control the electric cooling fan to cool the engine and A/C condenser. At cruising speed, the ECM may turn the fan off for better fuel economy. This control is on transverse engine front wheel drive vehicles.

Positive Crankcase Ventilation (PCV)

The PCV system passes crankcase vapors into the intake manifold. This system is not controlled by the ECM and is used on all engines.

ABBREVIATIONS AND GLOSSARY OF TERMS

Abbreviations used in this Section are listed below in alphabetical order with an explanation of the abbreviation. There are some variations in the use of periods and in capitalization (as mph, m.p.h., Mph, and MPH) for abbreviations used in this Section, but all types are acceptable.

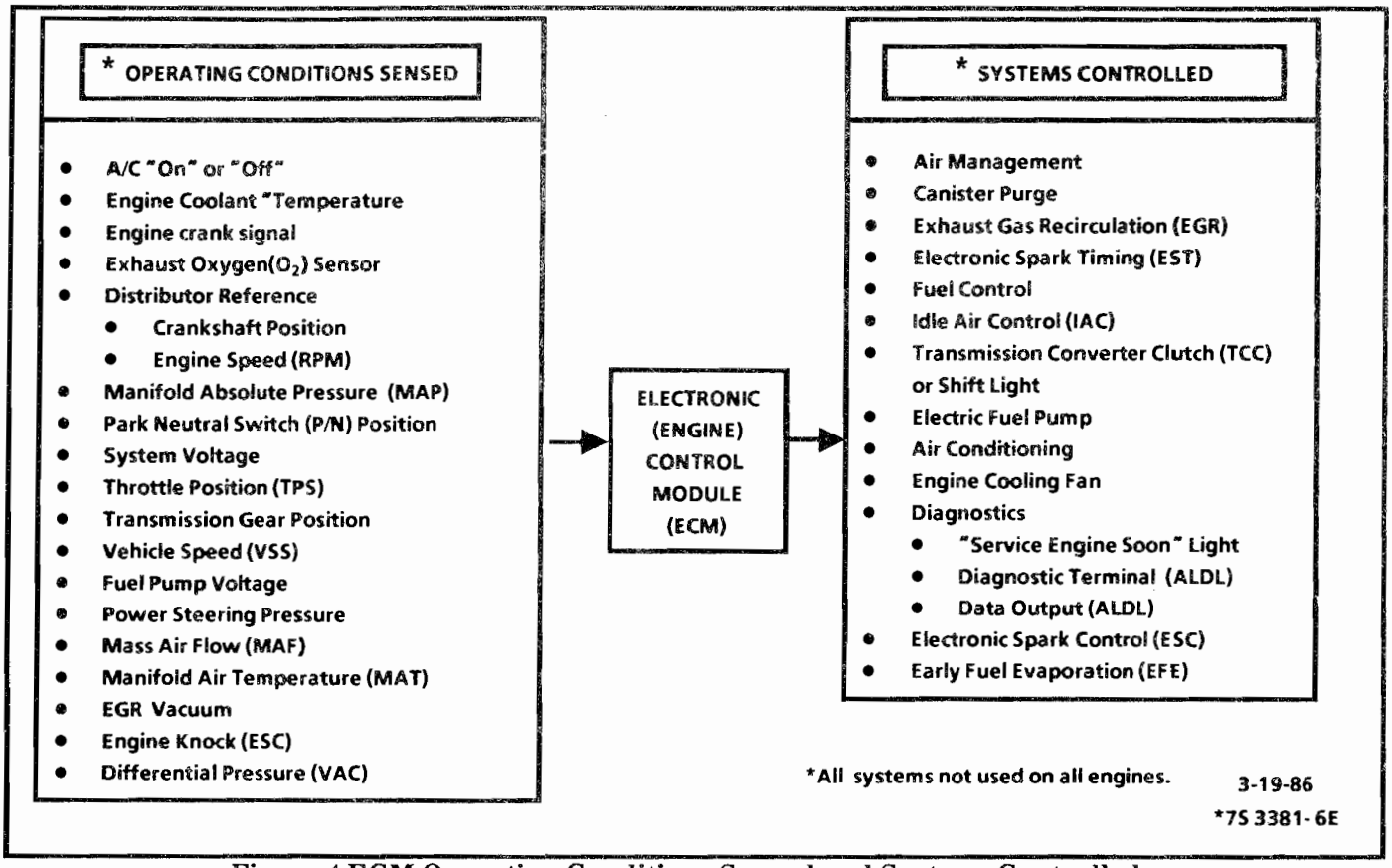


Figure 4 ECM Operating Conditions Sensed and Systems Controlled

A/F - AIR/FUEL (A/F RATIO)

AIR - AIR INJECTOR REACTION SYSTEM - Air flow from pump is directed into engine exhaust manifold and/or converter to reduce exhaust emissions.

ALDL - ASSEMBLY LINE DIAGNOSTIC LINK- Used at assembly to evaluate Computer Command Control and for service to flash the "SERVICE ENGINE SOON" light if there are trouble codes. Also used by "SCAN" tools to obtain ECM serial data.

Bat + - Battery Positive Terminal (12 Volts)

CALPAK - A device used with fuel injection to allow fuel delivery in the event of a PROM or ECM malfunction.

CALIBRATOR - (PROM). An electronic component which can be specifically programmed to meet engine operating requirements for each vehicle model. It plugs into the Engine Control Module (ECM).

CCC - COMPUTER COMMAND CONTROL - has an electronic control module to control air/fuel and emission systems.

C3I - Computer Controlled Coil Ignition. Produces the ignition spark without the aid of an ignition distributor.

CCP - CONTROLLED CANISTER PURGE - ECM controlled solenoid valve that permits manifold vacuum to purge the evaporative emissions from the charcoal canister.

CID - CUBIC INCH DISPLACEMENT - Used to describe engine size.

C LOOP - CLOSED LOOP

COOLANT TEMPERATURE SENSOR - Device that senses the engine coolant temperature, and passes that information to the electronic control module.

CONV. - CATALYTIC CONVERTER, THREE-WAY - EXHAUST CONVERTER. Containing platinum and palladium to speed up conversion of HC and CO, and rhodium to accelerate conversion of NOx.

CO - CARBON MONOXIDE - One of the pollutants found in engine exhaust.

DIAGNOSTIC CODE - Pair of numbers obtained from flashing "SERVICE ENGINE SOON" light. or displaying on a "Scan" tool. This code can be used to determine the system malfunction.

DIAGNOSTIC TERM. - Lead of ALDL Connector which is grounded to get a Trouble Code. It is grounded, with the engine running, to enter the "Field Service Mode".

DIS - Direct Ignition System. Produces the ignition spark without the aid of an ignition distributor.

DVM (10 Meg.) - Digital Voltmeter with 10 Million ohms resistance - used for measurement in electronic systems.

EAC - ELECTRIC AIR CONTROL - Used on A.I.R. System to direct air flow to Air Switching valve or atmosphere.

EAS - ELECTRIC AIR SWITCHING - Used to direct air flow to catalytic converter or exhaust ports of the engine.

ECM - ELECTRONIC ENGINE CONTROL MODULE - A metal case (located in passenger compartment) containing electronic circuitry which electrically controls and monitors air/fuel and emission systems on Computer Command Control, and turns on the "SERVICE ENGINE SOON" light when a malfunction occurs in the system.

EFI - ELECTRONIC FUEL INJECTION - Computer Command Control using throttle body Fuel injection.

EGR - EXHAUST GAS RECIRCULATION - Method of reducing NOx emission levels.

EECS - EVAPORATIVE EMISSIONS CONTROL SYSTEM - Used to prevent gasoline vapors in the fuel tank from entering the atmosphere.

EFE - EARLY FUEL EVAPORATION - Method of warming the intake manifold during cold engine operation. Provides efficient air/fuel mixing.

ENERGIZE/DE-ENERGIZE - When current is passed through a coil (energized) such as the Canister Purge Solenoid, the plunger is pulled into the solenoid. When the voltage to the solenoid is turned off, (de-energized), a spring raises the plunger.

ESC - ELECTRONIC SPARK CONTROL - Used to sense detonation and retard spark advance when detonation occurs.

EST - ELECTRONIC SPARK TIMING - ECM controlled timing of ignition spark.

EVRV - ELECTRONIC VACUUM REGULATOR VALVE. Controls EGR vacuum.

FED - FEDERAL - Vehicle/Engine available in all states except California.

GROUND - A Wire shorted to ground.

HC - HYDROCARBONS - One of the pollutants found in engine exhaust.

HIGH IMPEDANCE VOLTMETER - Has high opposition to the flow of electrical current. Good for reading circuits with low current flow, such as found in electronic systems because it allows tests to be made without affecting the circuit.

HEI - HIGH ENERGY IGNITION - A distributor that uses an electronic module and pick-up coil in place of contact points.

Hg - MERCURY - A calibration material used as a standard for vacuum measurement.

IAC - IDLE AIR CONTROL - Installed in the throttle body of fuel injected systems and controlled by the ECM to regulate idle speed.

IDEAL MIXTURE - The air/fuel ratio which provides the best performance, while maintaining maximum conversion of exhaust emissions, typically 14.7/1.

IGN - IGNITION

INPUTS - Information from sources (such as,coolant temperature sensors, exhaust oxygen sensor, etc.) that tell the ECM how the systems are performing.

INTERMITTENT - Occurs now and then; not continuously. In electrical circuits, refers to occasional open, short, or ground.

I.P. - INSTRUMENT PANEL

KM/HR - KILOMETER PER HOUR - A metric unit measuring distance (1000 meters) in one hour.

L - LITER - A metric unit of capacity.

L4 - FOUR CYLINDER IN-LINE ENGINE

MAF - MASS AIR FLOW - Sensor which measures the amount of air entering the engine.

MALFUNCTION - A problem that causes the system to operate incorrectly. Typical malfunctions are; wiring harness opens or shorts, failed sensors, or circuit components.

MAP - MANIFOLD ABSOLUTE PRESSURE SENSOR - Reads pressure changes in intake manifold with reference to zero pressure. It puts out a voltage which is highest when the pressure is highest. The maximum voltage is between 4-5 volts.

MAT - Manifold Air Temperature Sensor. Measures temperature of air in the intake manifold.

M/C - MIXTURE CONTROL

MEM-CAL - MEMORY CALIBRATOR - Contains specific caliobrations to meet the requirements of a specific engine..

MFI - MULTIPORT FUEL INJECTION. Individual injectors for each cylinder are mounted in the intake manifold. The injectors are fired in groups rather than individually.

MODE - A particular state of operation.

MPH - MILES PER HOUR - A unit measuring distance (5280 feet) in one hour.

N.C. - NORMALLY CLOSED - State of relay contacts or solenoid plunger when no voltage is applied.

N•m - NEWTON METERS (Torque) - A metric unit which measures force.

N.O. - NORMALLY OPEN - State of relay contacts or solenoid plunger when no voltage is applied.

NOx - NITROGEN, OXIDES OF - One of the pollutants found in engine exhaust.

O_2 - OXYGEN (Sensor) - Monitors the oxygen content of the exhaust system and generates a voltage signal to the ECM.

OPEN LOOP - Describes ECM fuel control without use of oxygen sensor information.

OUTPUT - Functions, typically solenoids, that are controlled by the ECM.

OXYGEN SENSOR, EXHAUST - Device that detects the amount of oxygen (O_2) in the exhaust stream.

POSITIVE CRANKCASE VENTILATION - Prevent fumes in crankcase from passing into atmosphere.

PFI - PORT FUEL INJECTION

P/N - PARK/NEUTRAL

PORT - EXHAUST OR INTAKE PORT

PROM - PROGRAMABLE READ ONLY MEMORY- An electronic term used to describe the engine calibration unit.

RPM - REVOLUTIONS PER MINUTE - A measure of rotational speed.

SELF-DIAGNOSTIC CODE - The ECM can detect malfunctions in the system. If a malfunction occurs, the ECM turns on the "SERVICE ENGINE SOON" light. A diagnostic code can be obtained from the ECM through the "SERVICE ENGINE SOON" light. This code will indicate the area of the malfunction.

SES - SERVICE ENGINE SOON LIGHT - Lights when a malfunction occurs in Computer Command Control system.

TACH - TACHOMETER

TBI - THROTTLE BODY INJECTION (Unit) - is controlled by the ECM to supply precise air/fuel mixture into the intake manifold.

TCC - TRANSMISSION / TRANSAXLE CONVERTER CLUTCH - ECM controlled solenoid in transmission which positively couples the transmission to the engine.

THERMAC - THERMOSTATIC AIR CLEANER - Provides preheated air to intake manifold to provide better driveability when engine is cold.

TPS - THROTTLE POSITION SENSOR - Device that tells the ECM the throttle position.

TVS - THERMAL VACUUM SWITCH - Used to control vacuum in relationship to engine temperature.

V - VOLT

V-6 - SIX CYLINDER ENGINE - Arranged in a "V".

V-8 - EIGHT CYLINDER ENGINE - Arranged in a "V".

VACUUM - Negative pressure; less than atmospheric pressure.

VACUUM, MANIFOLD - Vacuum source in manifold below throttle plate.

VACUUM, PORTED - A vacuum source above (atmospheric side) of closed throttle plate.

VIN - VEHICLE IDENTIFICATION NUMBER.

VSS - VEHICLE SPEED SENSOR - Sensor which sends vehicle speed information to the ECM.

WASTEGATE - A means of controlling the amount of boost available for a Turbo Charged engine.

WOT - WIDE OPEN THROTTLE.

WIRING HARNESS SERVICE

The ECM wire harness electrically connects the ECM to the various solenoids, switches, and sensors in vehicle engine compartment. The ECM is located inside the vehicle passenger compartment.

Most connectors in the engine compartment are protected against moisture and dirt which could create oxidation and deposits on the terminals. This protection is important because of the very low voltage and current levels found in the electronic system. The connectors have a lock which secures the male and female terminals together. A secondary lock holds the seal and terminal into the connector.

GENERAL

Molded-on connectors require complete replacement of the connector. This means splicing a new connector assembly into the harness. Figure 5 has instructions on splicing wires.

WIRE HARNESS

Wire harnesses should be replaced with proper part number harnesses. When signal wires are spliced into a harness, use wire with high temperature insulation only.

With the low current and voltage levels found in the system, it is important that the best possible bond at all wire splices be made by soldering the splices as shown in Figure 5.

Use care when probing the connector or replacing terminals in them. It is possible to short between opposite terminals. If this happens to the wrong terminal pair, it is possible to damage certain components. Always use jumper wires between connectors for circuit checking. NEVER probe through the Weather-Pack seals.

When diagnosing, open circuits are often difficult to locate by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may correct the open circuit condition. This should always be considered when an open circuit or failed sensor is indicated. Intermittent problems may also be caused by oxidized or loose connections.

Before making a connector repair, be certain of the type of connector. Weather-Pack and Compact Three connectors look similar but are serviced differently. Replacement connectors and terminals are listed in Group 8.965 of the Standard Parts Catalog.

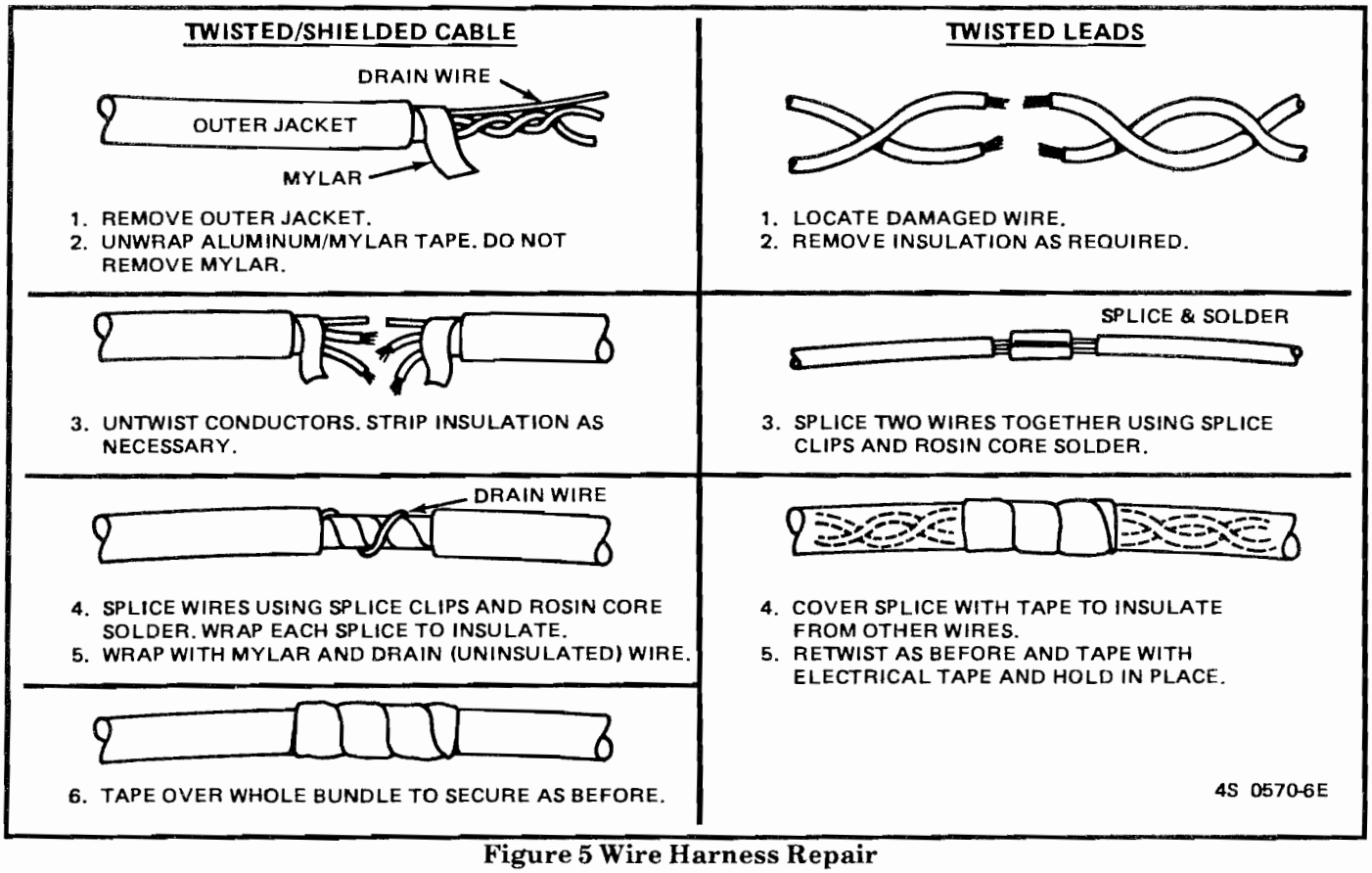


Figure 5 Wire Harness Repair

CONNECTORS

Weather-Pack

Some connectors used with an ECM are called Weather-Pack. Figure 6 shows a Weather-Pack terminal and the tool (J-28742) required to service it. This tool is used to remove the pin and sleeve terminals. If removal is attempted with an ordinary pick, there is a good chance that the terminal will be bent or deformed. and, unlike standard blade type terminals, these terminals cannot be straightened once they are bent.

Make certain that the connectors are properly seated and all of the sealing rings in place when connecting leads. The hinge type flap provides a backup, or secondary locking feature for the connector. They are used to improve the connector reliability by retaining the terminals if the small terminal lock tangs are not positioned properly.

Weather-Pack connections cannot be replaced with standard connections. Instructions are provided with Weather-Pack connector and terminal packages.

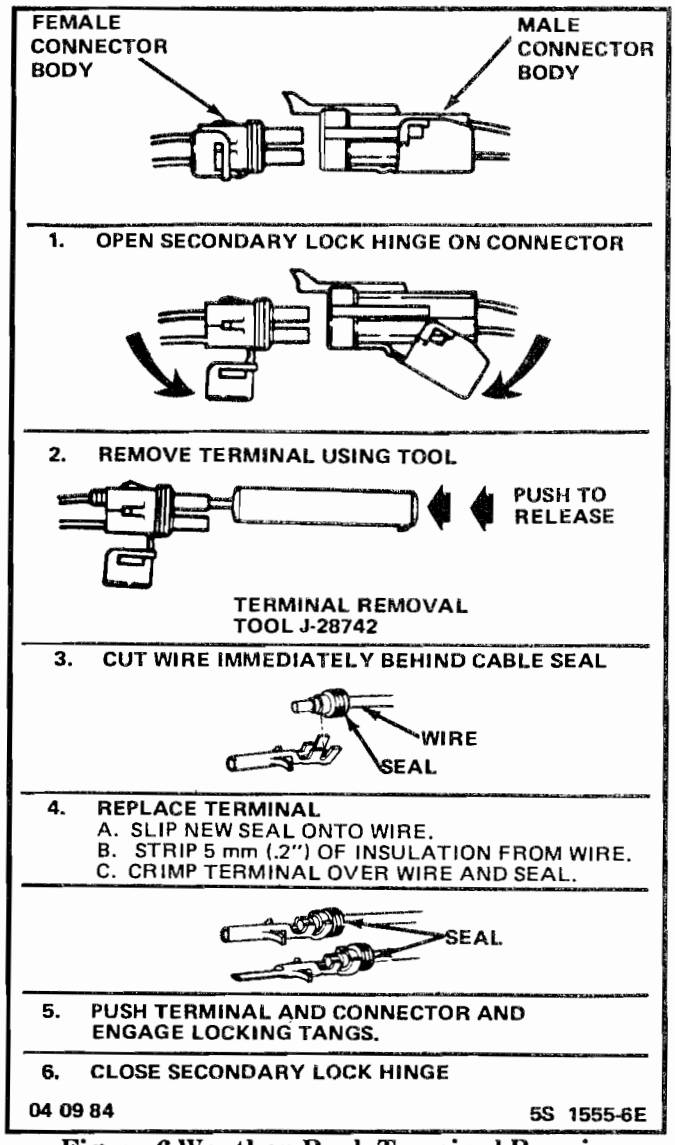


Figure 6 Weather-Pack Terminal Repair

Compact Three

The Compact Three connector which looks similar to a Weather-Pack connector is not sealed and is used where resistance to the environment is not required. This type of connector most likely is used at the air control solenoid. Use the standard method when repairing a terminal. Do not use the Weather-Pack terminal tool J-28742.

Metri-Pack Series 150 terminal removal

Some connectors used to connect various sensors to the ECM harness use terminals called "Metri-Pack" (Figure 7). These may be used at the Coolant Sensors as well as at Ignition Modules.

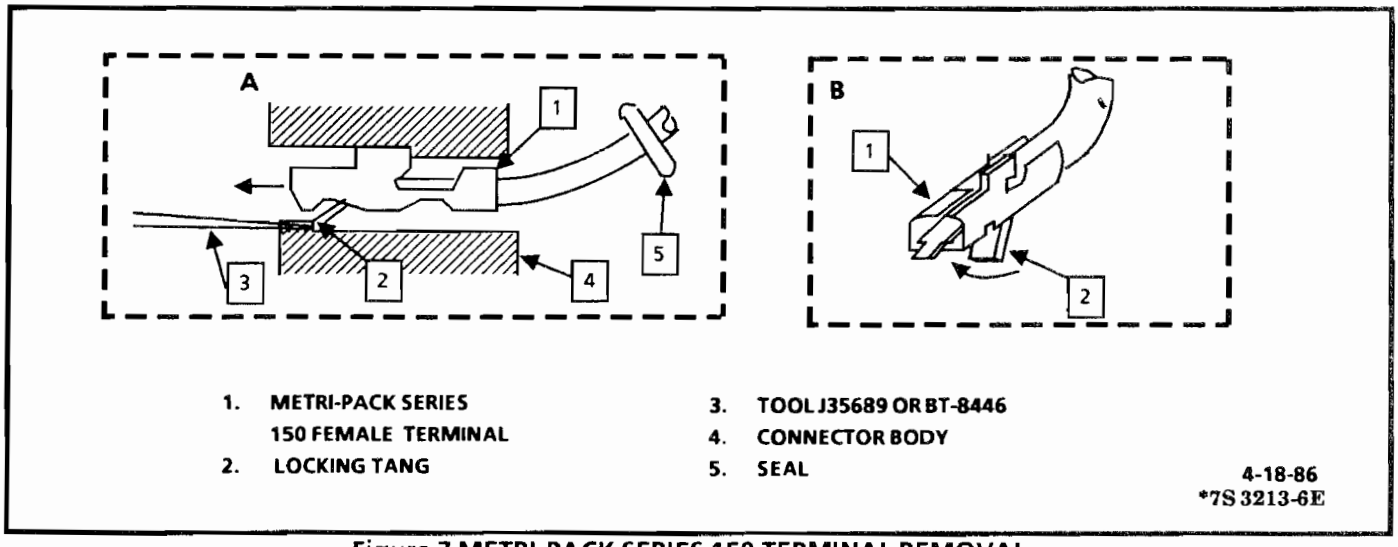
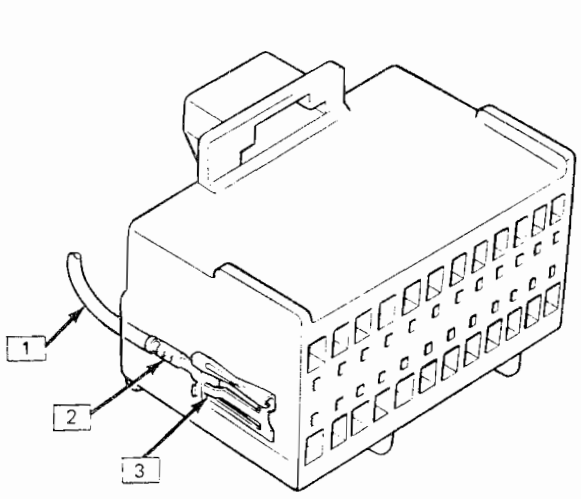
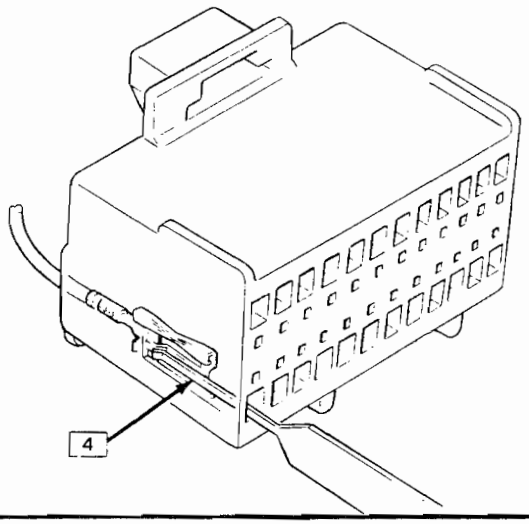


Figure 7 METRI-PACK SERIES 150 TERMINAL REMOVAL





1 CABLE
2 TERMINAL
3 LOCKING TANG
4 TOOL J33095

1. GRASP CABLE AND PUSH TERMINAL TO THE MOST FORWARD POSITION.
2. INSERT TOOL J33095 STRAIGHT INTO THE FRONT OF THE CONNECTOR CAVITY. DO NOT USE CONVENTIONAL PICK TO REMOVE TERMINAL.
3. WITH TOOL IN PLACE, GENTLY PULL ON THE CABLE TO REMOVE TERMINAL.
4. VISUALLY CHECK TERMINAL AND REPLACE IF TERMINAL CAVITY OR TANG IS DAMAGED.
5. INSTALL TERMINAL INTO CONNECTOR CAVITY UNTIL LOCKING TANG HAS SNAPPED INTO POSITION.

03 21 84

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Figure 8 Micro Pack Terminal Replacement

They are also called "Pull-To-Seat" terminals because, to install a terminal on a wire the wire is first inserted through the seal (5) and connector (4). The terminal is then crimped on the wire and the terminal pulled back into the connector to seat it in place.

To remove a terminal:

1. Slide the seal back on the wire,
2. Insert tool (3) BT-8518 or J 35689, or equivalent, as shown in insert "A" and "B" to release the terminal locking tab (2).
3. Push the wire and terminal out through the connector.

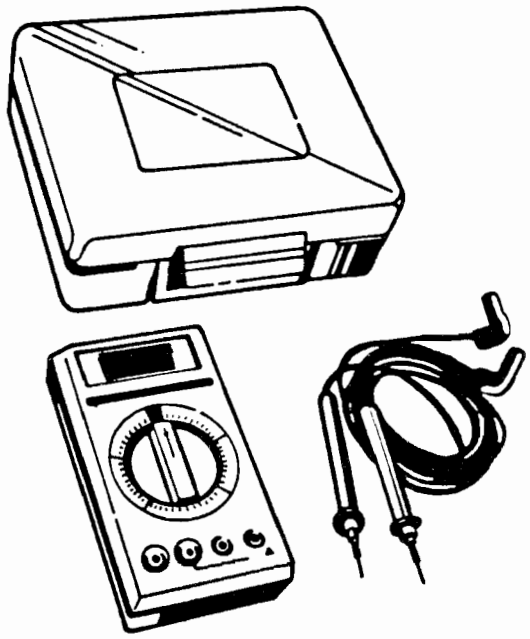
If reusing the terminal, reshape the locking tang (2).

Micro-Pack

Some connectors used on harness to connect to the ECM are called Micro-Pack (Figure 8). Terminal replacement requires the use of a special tool.

TOOLS NEEDED TO SERVICE THE SYSTEM

The system requires an ALDL read-out (Scan) tool, tachometer, test light, ohmmeter, digital voltmeter with 10 megohms impedance (J-29125A), vacuum gage and jumper wires for diagnosis. A test light, or voltmeter, must be used when specified in the procedures. They must NOT be interchanged. See Figures 9 through 12 for Special Tools needed to diagnosis or repair a system. For more complete information on the operation of these tools, see the manufacturer's instructions.



HIGH IMPEDANCE MULTIMETER
(DIGITAL VOLTMETER-DVM)
J34029-A

VOLTMETER - Voltage Position Measures amount of voltage. When connected in parallel to an existing circuit. A digital voltmeter with 10 meg ohm input impedence is used because this type of meter will not load down the circuit and result in faulty readings.some circuits require accurate low voltage readings, and some circuits in the ECM have a very high resistance .

AMMETER - When used as ammeter, this meter also accurately measures extremely low current flow. Refer to meter instructions for more information.

- Selector must be set properly for both function and range. DC is used for most automotive measurements.

OHMMETER - Measures resistance of circuit directly in ohms. Refer to meter for more information.

- OL Display in all ranges indicates open circuit.
- Zero display in all ranges indicates a short circuit.
- Intermittent connection in circuit may be indicated by digital reading that will not stabilize on circuit.
- Range Switch.
  - 200Ω – Reads ohms directly
  - 2K,20K,200KΩ – Reads ohms in thousands
  - 2M and 20MΩ - Reads ohms in millions



J23738

VACUUM PUMP (20 IN. HG. MINIMUM)
Use gage to monitor manifold engine vacuum and the hand pump to check vacuum sensors, solenoids and valves.

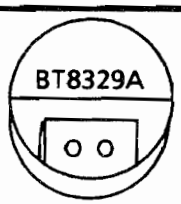


J34142-A

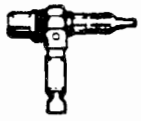
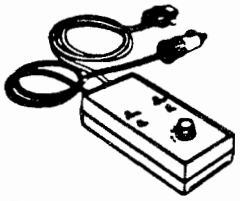
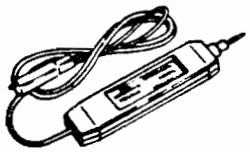
UNPOWERED TEST LIGHT
Used to check wiring for complete circuit and short to ground or voltage.



TACHOMETER
Use inductive trigger signal pickup type to check RPM.

 J29533A/BT8127	**OXYGEN SENSOR WRENCH** Used to remove or install the oxygen sensor.
 J33031/BT8130	**IDLE AIR CONTROL WRENCH** Used to remove or install IAC valve on throttle body.
 J34730-A	**PORT FUEL INJECTION DIAGNOSTIC KIT** Used to diagnose port fuel injection systems. The kit includes: • Fuel Pressure Gage - to check fuel pump pressure and compare injector pressure drop for equal fuel distribution. • Injector Test Light - to check electrical circuit to an injector. • Injector Tester - to energize each fuel injector for a precise amount of time to perform injector balance test in CHART C-2A by checking each injector's pressure drop using pressure gage.
 J34730-1	**FUEL PRESSURE GAGE** Used to check and monitor fuel line pressure of port fuel system. Part of Diagnostic Kit J34730-A
 J34730-2	**INJECTOR TEST LIGHT** Used to check electrical circuit to a port fuel injector Part of Diagnostic Kit J34730-A
 BT8320	**INJECTOR TEST LIGHT** Used to check electrical circuit to a TBI fuel injector (except TBI 700)
 BT8329A	**INJECTOR TEST LIGHT** Used to check electrical circuit to a TBI 700 fuel injector and a port fuel injector.

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 J26792/BT7220-1	**SPARK TESTER** Use to check available secondary ignition voltage . Also called an ST125.
 J36101	**MASS AIR FLOW (MAF) SENSOR TESTER** Used for static test of MAF Sensor on vehicles equipped with an A/C type MAF Sensor.
 J36179	**CRANKSHAFT SENSOR ALIGNMENT TOOL (C3I SYSTEMS)** Used to properly align crank or combination sensor to harmonic balancer interrupter.
 J35616	**CONNECTOR TEST ADAPTER KIT** Used to make electrical test connections in current Weather Pack, Metri - Pack and Micro-Pack style terminals.
 J34636	**CIRCUIT TESTER** Used to check all relays and solenoids before connecting them to a new ECM. Measures the circuit resistance and indicates pass or fail via green or red LED. Amber LED indicates current polarity. Can also be used as a non-powered continuity checker.
 J28687-A/BT8220	**OIL PRESSURE TRANSDUCER WRENCH** Used to remove or install oil pressure transducer on engine.
 J35689	**METRI-PACK TERMINAL REMOVER** Used to remove 150 series Metri-Pack "pull-to-seat" terminals from connectors. Refer to wiring harness service in Section 6E for removal procedure.
 J28742/BT8234-A	**WEATHER PACK TERMINAL REMOVER** Used to remove Terminals from Weather Pack connectors. Refer to wiring harness service in Section 6E for removal procedure.
 J33095/BT8234-A	**ECM CONNECTOR TERMINAL REMOVER** Used to remove terminal from Micro-Pack connectors. Refer to wiring harness service Section 6E for removal procedure.

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 J34730-3	**INJECTOR TESTER** to energize each fuel injector for a precise amount of time to perform injector balance test in CHART C-2A by checking each injector's pressure drop using pressure gage. Part of Diagnostic Kit J34730-A.
 J29698-A/BT8251	**FUEL LINE WRENCH** Used to disconnect or connect fuel lines at TBI unit by holding fuel nut at throttle body.
 J33179-20	**MINIMUM AIR RATE ADJUSTING WRENCH** Used to adjust throttle stop screw on TBI unit.
 J29658/BT8205	**FUEL PRESSURE GAGE** Used to check and monior fuel line pressure of port fuel system.

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GENERAL SPECIFICATIONS

Many of the specifications used in this section are located on the Vehicle Emission Control Information label under the hood.

Listed on the chart below are locations of specifications used in this Section.

SPECIFICATION	LOCATION OF INFORMATION
Engine Timing	Vehicle Emission Control information label.
Idle Speed, ECM Controlled	Not adjustable. ECM controls idle.
Spark Plug Type	See Owner's Manual, Section 7.
Spark Plug Gap	Vehicle Emission Control Information Label.
Engine Code	8th digit of VIN number. See Section OA. Also Owner's Manual, Section 7.
Engine Family	Vehicle Emission Control Information label.
Filter Part Numbers	See Owner's Manual, Section 7.
Part Numbers of Major Components	WDD-GM Parts Book.
Replacement of Vehicle Emission Control Information Label	WDD-GM Label Catalog.

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SECTION 6E3
DRIVEABILITY AND EMISSIONS FUEL INJECTION (PORT)

THIS SECTION APPLIES TO:

5.7L L98 ("Y" SERIES) VIN CODE 8

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ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE, TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

INTRODUCTION

GENERAL DESCRIPTION

This Section applies to engines which have a fuel injector in the intake manifold near the intake valve for each cylinder. It is commonly referred to as "Port Fuel Injection".

These engines have controls to reduce exhaust emissions, while maintaining good driveability and fuel economy.

An Engine Control Module (ECM) is the heart of this control system and has sensors used to provide information about engine operation and the various systems it controls. Details of basic operation, diagnosis, functional checks, and on-vehicle service are covered in Section "C", Component Systems.

The ECM has the ability to do some diagnosis of itself, and of other parts of the system. When it finds a problem, it lights a "Service Engine Soon" light on the instrument panel and a trouble code will be stored in the ECM memory. This does not mean that the engine should be stopped right away, but that the cause of the light coming "ON" should be checked as soon as reasonably possible.

DIAGNOSIS PROCEDURE

The following Sections(s) are written for specific engine applications and are clearly indentified. Be sure to use only the section which applies to the engine family being diagnosed.

Before using this Section of the manual, you should be familiar with the information and the proper diagnosing procedures as described in Section 6E. If the proper diagnosis procedures are not followed, as described in Section "6E", it may result in unnecessary replacement of good parts.

Trouble Tree Charts incorporate diagnosis procedures using an ALDL "Scan" tool, where possible. The "Scan" tool has the ability to save time in diagnosis and prevent the replacement of good parts. **The key to using the "Scan" tool successfully for diagnosis lies in the technician's ability to understand the system he is trying to diagnose, as well as an understanding of the "Scan" tool's limitations. See Section "6E" for more information.**

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SECTION A
5.7L ENGINE

BASIC PROCEDURE

If you have not reviewed the Basic Information on how to use the Diagnostic Procedures, go to the Introduction of this section. The facing page of each chart in this Section will provide a general circuit description and in some instances, alternate diagnostic steps or other diagnostic aids specific to that chart or circuit.

DIAGNOSTIC CIRCUIT CHECK

The "Diagnostic Circuit Check" verifies the system is functioning correctly. Some special considerations to keep in mind while making the "Diagnostic Circuit Check" are:

Blocking Drive Wheels

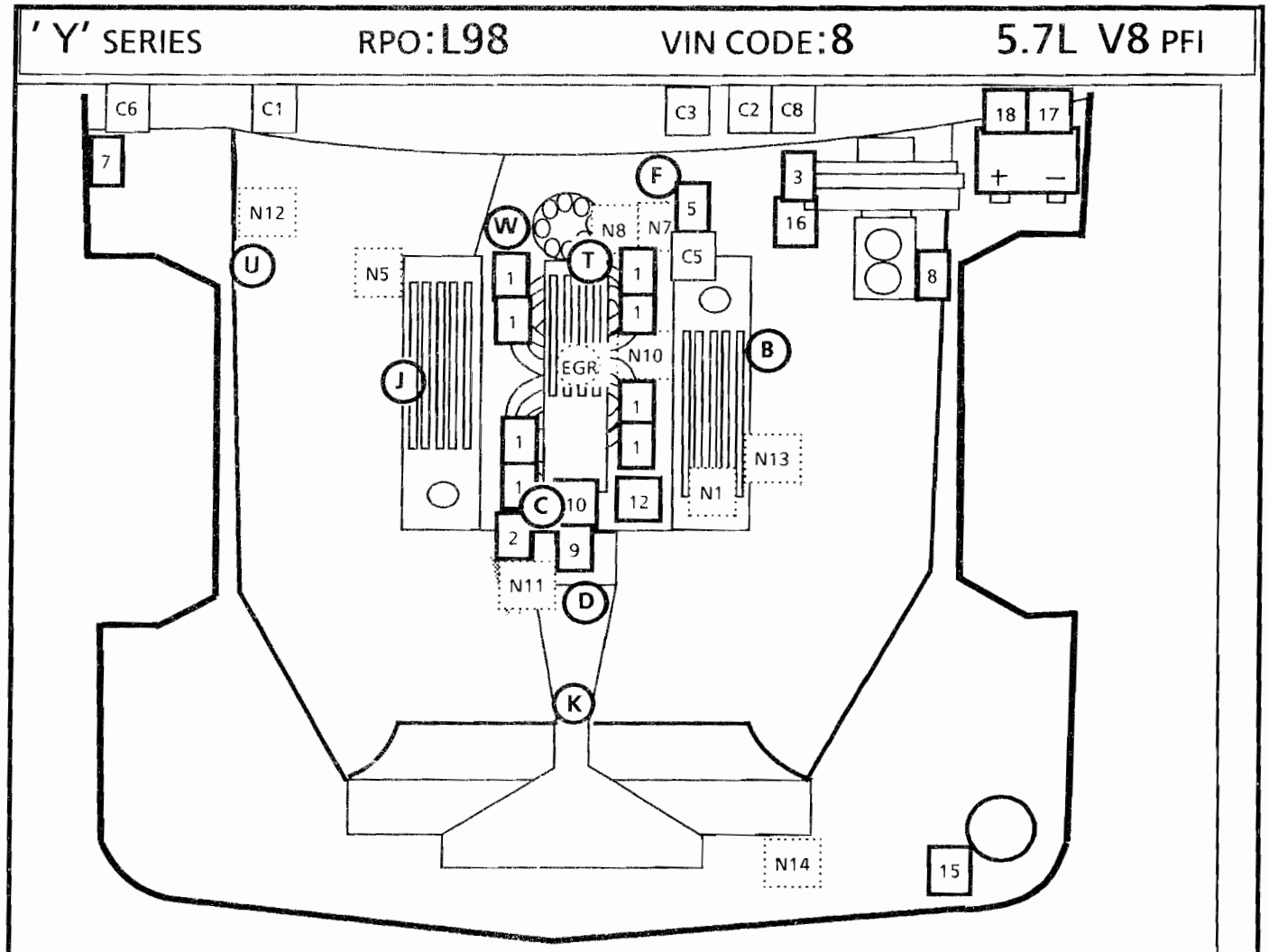
The vehicle drive wheels should always be blocked while checking the system.

Cold Oxygen Sensor

On some engines, the Oxygen Sensor will cool off after only a short period of operation at idle. This will put the system into "Open Loop". To restore "Closed Loop" operation, run the engine at part throttle several minutes and accelerate from idle to part throttle a few times.

SECTION A
ENGINE COMPONENTS / WIRING DIAGRAMS / DIAGNOSTIC CHARTS

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Code 54 Fuel Pump Circuit (Low Voltage) ..... Page A-60



COMPUTER HARNESS

- C1 Electronic Control Module (ECM)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector (ALDL"G")

NOT ECM CONNECTED

- N1 Crankcase vent valve (PCV)
- N5 Engine temp. sensor (gage.overheat)
- N7 Oil pressure sensor (gage)
- N8 Oil pressure switch (fuel pump)
- N10 Cold start valve
- N11 Cold start Fuel injection switch
- N12 A/C pressure cycling switch
- N13 Fan Switch (H.D. Cooling)
- N14 H.D. Cooling Fan Relay

CONTROLLED DEVICES

- 1 Fuel injector
- 2 Idle air control motor
- 3 Fuel pump relay
- 5 Trans. Converter Clutch connector
- 7 Electronic Spark Control module
- 8 Engine fan relay
- 9 Air injection divert valve
- 10 Air injection switching valve
- 12 Exh. Gas Recirc. vacuum solenoid
- 15 Fuel vapor canister solenoid
- 16 Transmission overdrive relay (M/T)
- 17 MAF sensor power relay
- 18 MAF sensor burn-off relay

INFORMATION SENSORS

- B Exhaust oxygen
- C Throttle position
- D Coolant temperature
- F Vehicle speed
- J ESC knock
- K Mass Air Flow
- T Manifold Air Temperature
- U A/C pressure switch
- W EGR diagnostic temp. switch

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Figure A-1 - 5.7L Component Locations "Y" Series

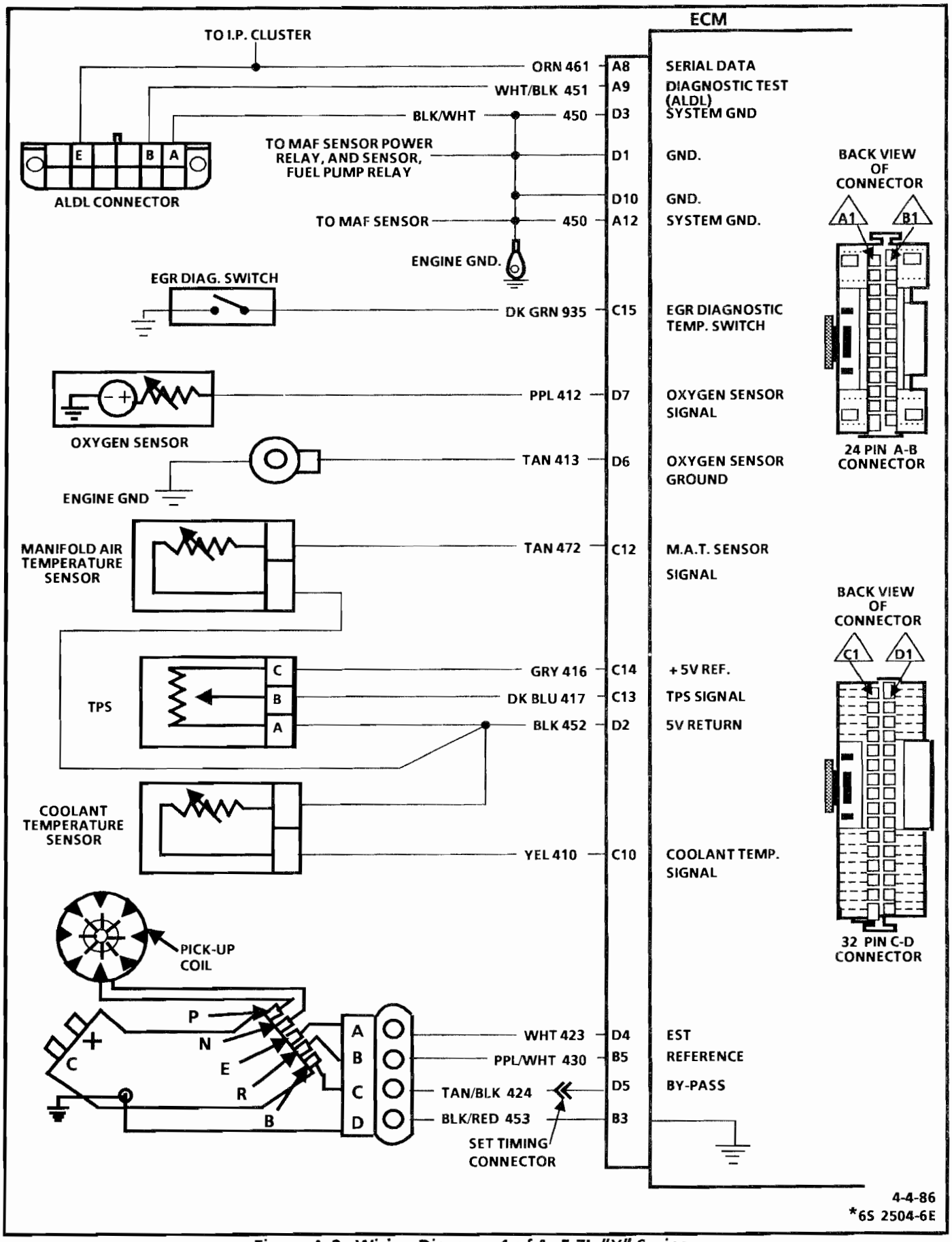


Figure A-2 - Wiring Diagram, 1 of 4 - 5.7L,"Y" Series

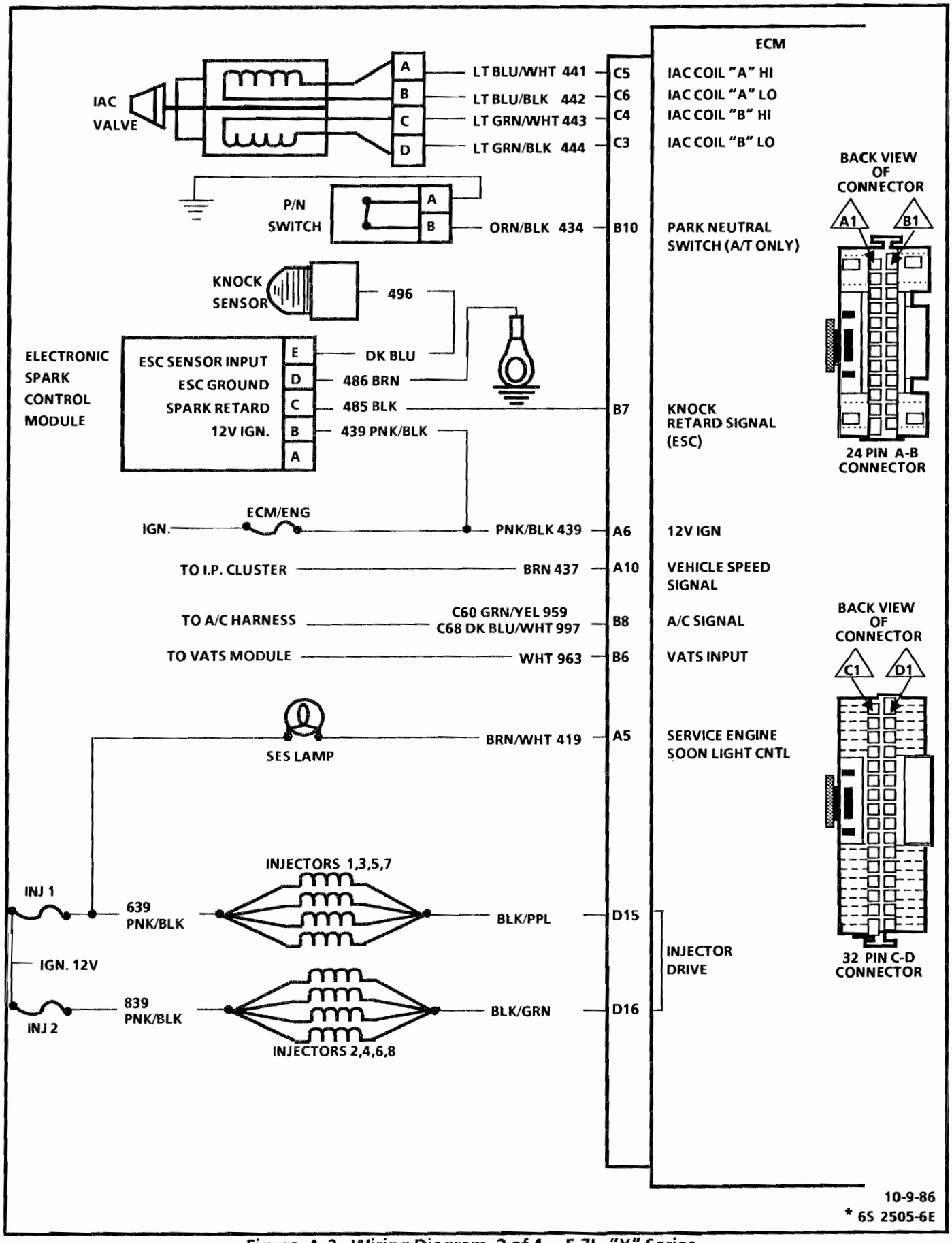


Figure A-3 - Wiring Diagram, 2 of 4 - 5.7L, "Y" Series

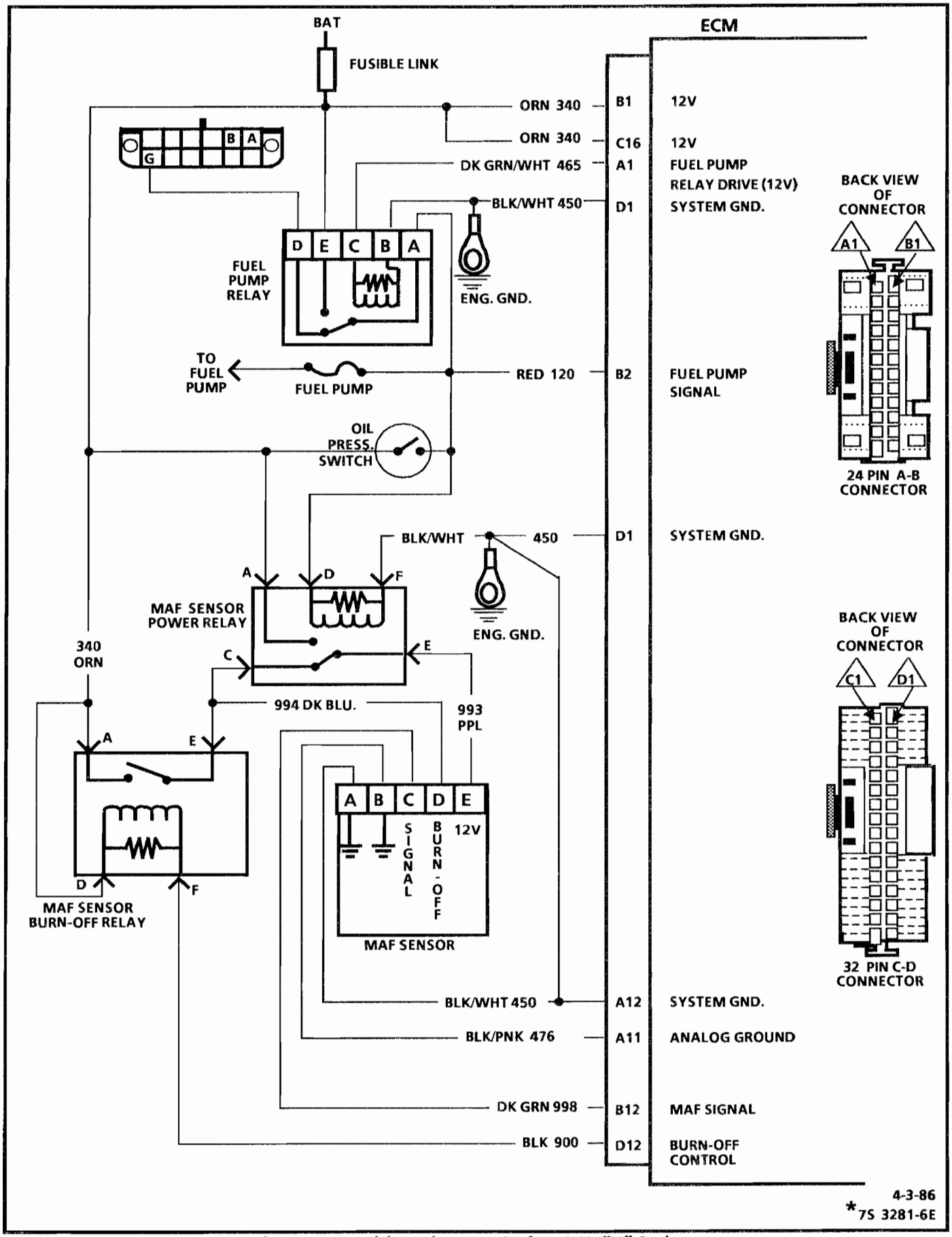


Figure A-4 - Wiring Diagram, 3 of 4 - 5.7L,"Y" Series

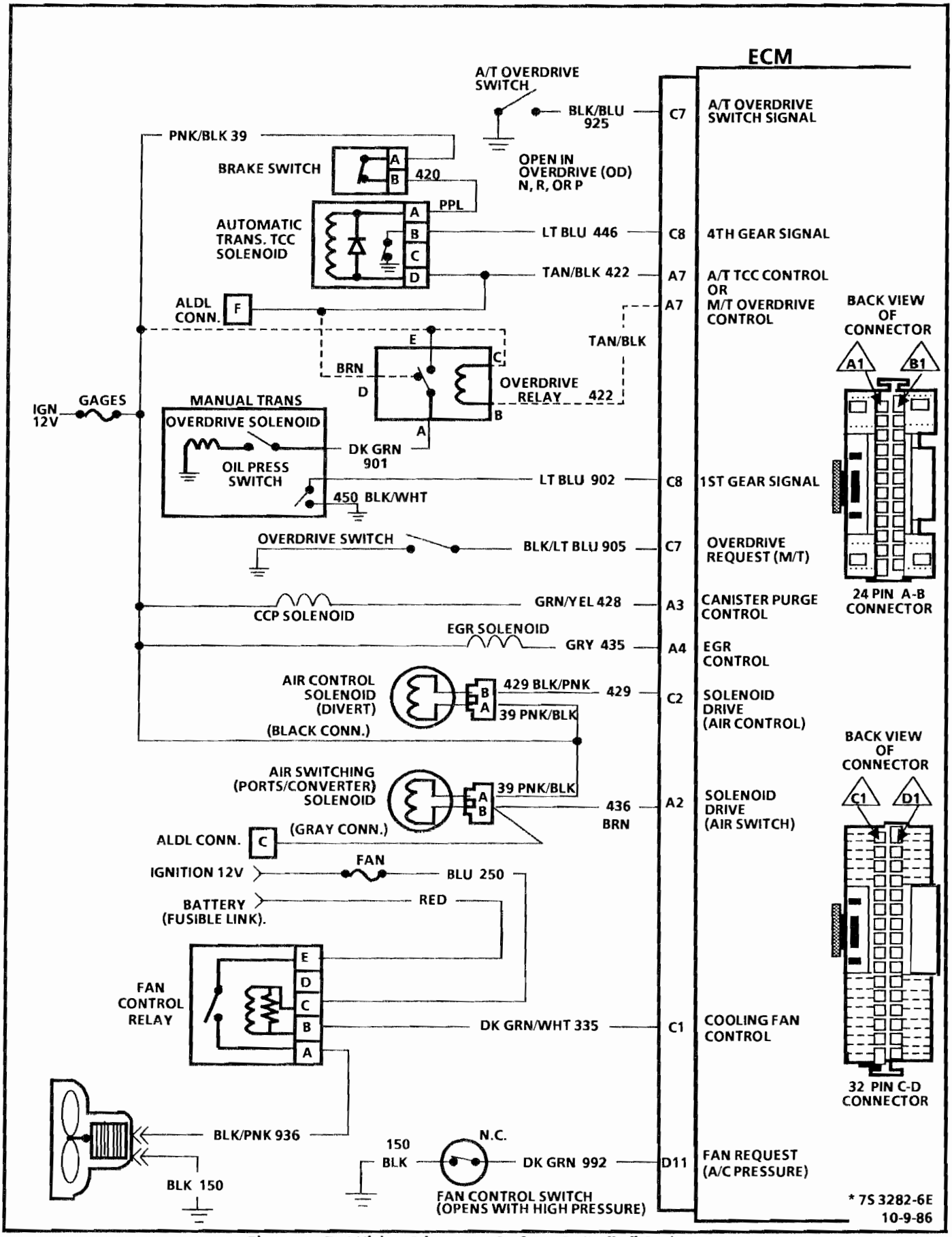


Figure A-5 - Wiring Diagram, 4 of 4 - 5.7L, "Y" Series

PORT FUEL INJECTION ECM CONNECTOR IDENTIFICATION

This ECM voltage chart is for use with a digital voltmeter to further aid in diagnosis. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

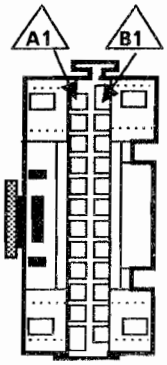
B + in Chart refers to system voltage.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

• Engine at operating temperature • Engine idling in "Closed Loop" (for "Engine Run" column) in park or neutral • Test terminal not grounded • "Scan" tool not installed

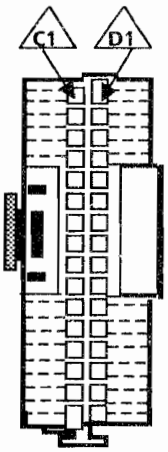
	VOLTAGE				
	KEY "ON"	ENG. RUN	CIRCUIT	PIN	WIRE COLOR
(3)	0*	B +	FUEL PUMP RELAY	A1	GRN/ WHT
	B +	B +	AIR SWITCH SOLENOID	A2	BRN
	B +	1∇	CANISTER PURGE SOLENOID	A3	GRN/ YEL
	B +	1∇	EGR SOLENOID	A4	GRY
	1∇	B +	"SERVICE ENGINE SOON" LIGHT	A5	BRN/ WHT
	B +	B +	IGNITION	A6	PNK/ BLK
	B +	B +	M/T OVERDRIVE OR A/T TCC CONTROL	A7	TAN/ BLK
	2-5 varies	2-5 varies	SERIAL DATA	A8	ORN
	5	5	DIAG. TERM.	A9	WHT/ BLK
(1)			SPEED SENSOR SIGNAL	A10	BRN
	0*	0*	MAF SENSOR GROUND	A11	BLK/ PNK
	0*	0*	ECM GROUND	A12	BLK/ WHT
	B +	B +	FAN RELAY	C1	DK GRN/ WHT
	B +	1∇	AIR CONTROL SOLENOID	C2	BLK/ PNK
	NOT USEABLE		IAC "B" LO	C3	LT GRN/ BLK
	NOT USEABLE		IAC "B" HI	C4	LT GRN/ WHT
	NOT USEABLE		IAC "A" HI	C5	LT BLU WHT
	NOT USEABLE		IAC "A" LO	C6	LT BLU BLK
	B + B +	B + B +	O/D SWITCH (A/T) O/D REQ. (M/T)	C7	BLK/ LT BLU
	0* 0*	0* 0*	4TH GR. SIG. (A/T) 1ST GR. SIG. (M/T)	C8	LT BLU
			NOT USED	C9	
(4)	1.7	1.7	COOLANT TEMP. SIGNAL	C10	YEL
			NOT USED	C11	
(4)	2.0	2.0	MAT SIGNAL	C12	TAN
	.54V ± .08V	.54V ± .08V	TPS SIGNAL	C13	DK BLU
	5	5	TPS 5 VOLT REFERENCE	C14	GRY
	B +	B +	EGR DIAG.SWITCH	C15	DK GRN
	B +	B +	CONTINUOUS BATTERY VOLTAGE	C16	ORN

BACK VIEW OF CONNECTOR



24 PIN A-B CONNECTOR

BACK VIEW OF CONNECTOR



32 PIN C-D CONNECTOR

	VOLTAGE				
	WIRE COLOR	PIN	CIRCUIT	KEY "ON"	ENG. RUN
	ORN	B1	CONTINUOUS BATTERY VOLTAGE	B +	B +
(3)	RED	B2	FUEL PUMP SIGNAL	0*	B +
	BLK/ RED	B3	IGNITION GROUND	0*	0*
		B4	NOT USED		
	PPL/ WHT	B5	DISTRIBUTOR REFERENCE	0*	1.3
	WHT	B6	VATS	2.5	2.5
	BLK	B7	ESC SIGNAL	9.2	9.3
(5)	GRN/ YEL	B8	(OFF) A/C SIGNAL (ON) (C60)	0* B +	0* B +
		B9	NOT USED		
	ORN/ BLK	B10	PARK/NEUTRAL P/N SW.SIGNAL (A/T) D	0* B +	0* B +
		B11	NOT USED		
(2)	DK GRN	B12	MAF SENSOR SIGNAL	2.5	.4-1
	BLK/ WHT	D1	ECM GROUND	0*	0*
	BLK	D2	TPS,CTS,MAT SENSOR GROUND	0*	0*
	BLK/ WHT	D3	ECM GROUND	0*	0*
	WHT	D4	EST	0*	1.3
	TAN/ BLK	D5	BYPASS	0*	4.75
	TAN	D6	O_2 GROUND	0*	0*
(2)	PPL	D7	O_2 SENSOR SIGNAL	.35-.55	.01-.99
		D8	NOT USED		
		D9	NOT USED		
	BLK/ WHT	D10	ECM GROUND	0*	0*
	DK GRN	D11	A/C PRESSURE FAN SWITCH	0*	0*
	BLK	D12	MAF BURN-OFF RELAY	B +	B +
		D13	NOT USED		
		D14	NOT USED		
	BLK/PPL	D15	INJ.1,3,5,7.	B +	B +
	BLK/GRN	D16	INJ.2,4,6,8.	B +	B +

∇ Less than 1 volt.
* Less than .5 volts.
1. Varies from .60 to battery voltage depending on position of drive wheels.
2. Varies.
3. 12V First two seconds.
4. Varies with temperature.
5. With A/C option C68 there should be 5-7 volts with A/C ON and the wire color is blu/wht.

ENGINE 5.7 L98

CARLINE CORVETTE

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Figure A-6 - 5.7L ECM Connector Terminal End View "Y" Series

DIAGNOSTIC CIRCUIT CHECK

The Diagnostic Circuit Check is an organized approach to identifying a problem created by an Electronic Engine Control System malfunction. It must be the starting point for any driveability complaint diagnosis, because it directs the Service Technician to the next logical step in diagnosing the complaint.

The "Scan Data" listed in the table may be used for comparison, after completing the Diagnostic Circuit Check and finding the on-board diagnostics functioning properly and no trouble codes displayed. The "Typical Values" are an average of display values recorded from normally operating vehicles and are intended to represent what a normally functioning system would typically display.

A "SCAN" TOOL THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED, AND THE PROBLEM SHOULD BE REPORTED TO THE MANUFACTURER. THE USE OF A FAULTY "SCAN" CAN RESULT IN MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

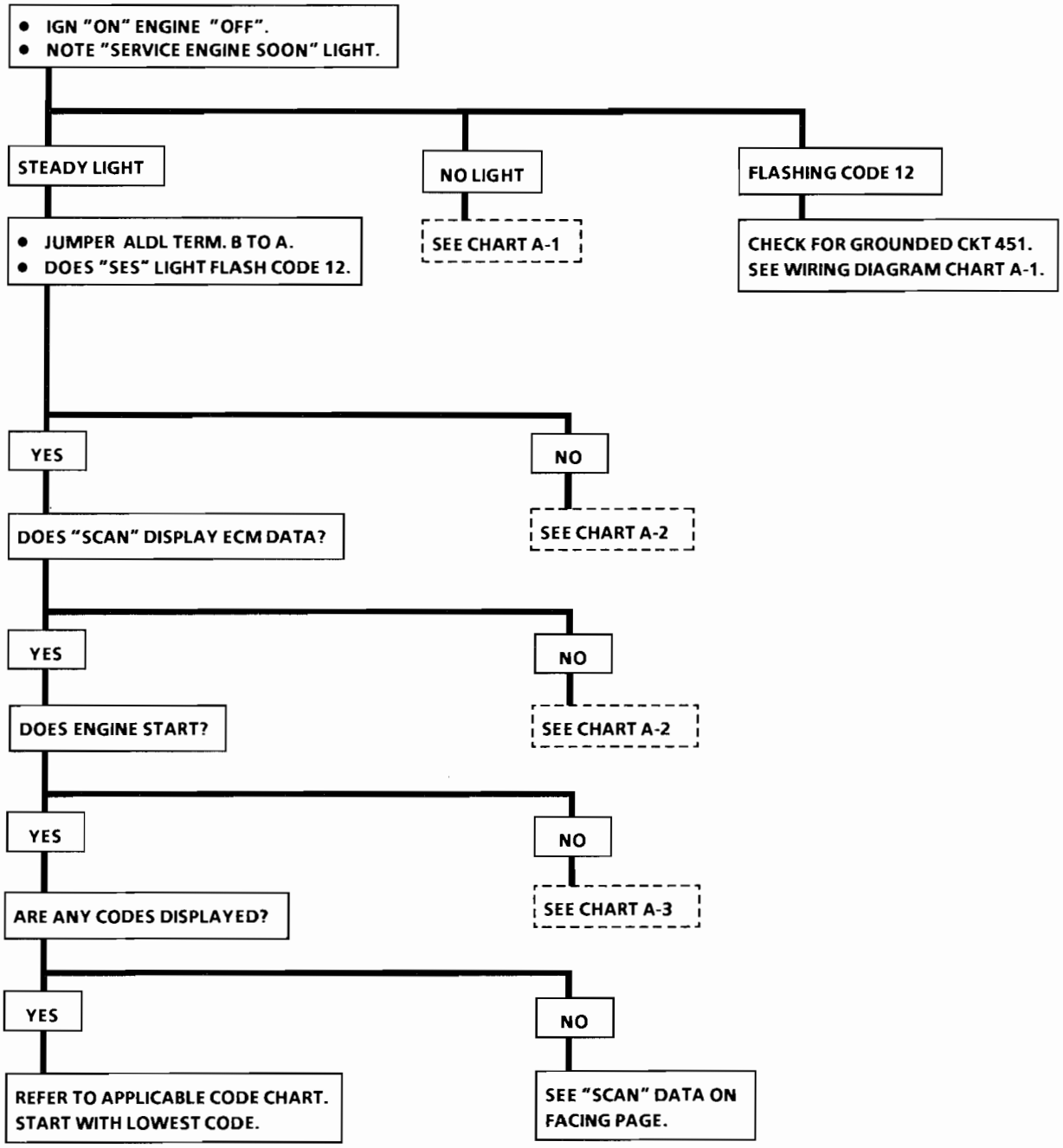
Only the parameters listed below are used in this manual for diagnosing. If a "Scan" reads other parameters, the values are not recommended by General Motors for use in diagnosing. For more description on the values and use of the "Scan" to diagnosis ECM inputs, refer to the applicable diagnosis section in Section C. If all values are within the range illustrated, refer to symptoms in Section B.

"SCAN" DATA

Idle / Upper Radiator Hose Hot / Closed Throttle / Park or Neutral / Closed Loop / Acc. off

"SCAN" Position	Units Displayed	Typical Data Value
Desired RPM	RPM	ECM idle command (varies with temp.)
RPM	RPM	± 100 RPM from desired RPM (± 50 in drive)
Coolant Temp.	C°	85° - 105°
MAT Temp.	C°	10° - 90° (depends on underhood temp.)
MAF	Gm/Sec	4 - 7
Air Flow	Gm/Sec	4 - 7
BPW (base pulse width)	M/Sec	1 - 4 and varying
O_2	Volts	1-1000 and varying
TPS	Volts	.46 - .62
IAC	Counts (steps)	1 - 40
INT (Integrator)	Counts	Varies
BLM (Block Learn)	Counts	118 - 138
Open/Closed Loop	Open/Closed	Closed Loop (may go open with extended idle)
BLM Cell	Cell Number	0 or 1 (depends on Air Flow & RPM)
VSS	MPH	0
TCC	On/Off	Off/ (on with TCC commanded)
Battery	Volts	13.5 - 14.5
PPSW	Volts	13.5 - 14.5
LV8	Counts	30 - 60
Knock Retard	Degrees of Retard	0
Spark Advance	# of Degrees	Varies
P/N Switch	P/N and RDL	Park/Neutral (P/N)
Overdrive Request (A/T)	Yes/No	Yes (no, when in 1, 2, or D.range)
A.I.R. Control	Normal/Divert	Normal
A.I.R. Switch	Port/Converter	Converter
A/C Request	Yes/No	No (yes, with A/C requested)
Fan Request	Yes/No	No (yes, with A/C high pressure)
EGRDC	0 - 100%	0 at idle
EGR Diagnostic	On/Off	off
Fan	On/Off	Off (below 108°C)
CCP duty cycle	0 - 100%	0
Knock Signal	Yes/No	No (yes, when knock is detected)
Shift Light (M/T)	On/Off	Off
Ist gear sw. (M/T)	yes/no	No (yes, when in 1st gear)
Overdrive Switch (M/T)	Open/Closed	Open (Closed, with overdrive button pushed)
4th Gear (A/T)	Yes/No	No (yes, when in 4th gear)

DIAGNOSTIC CIRCUIT CHECK
5.7L "Y" SERIES (PORT)



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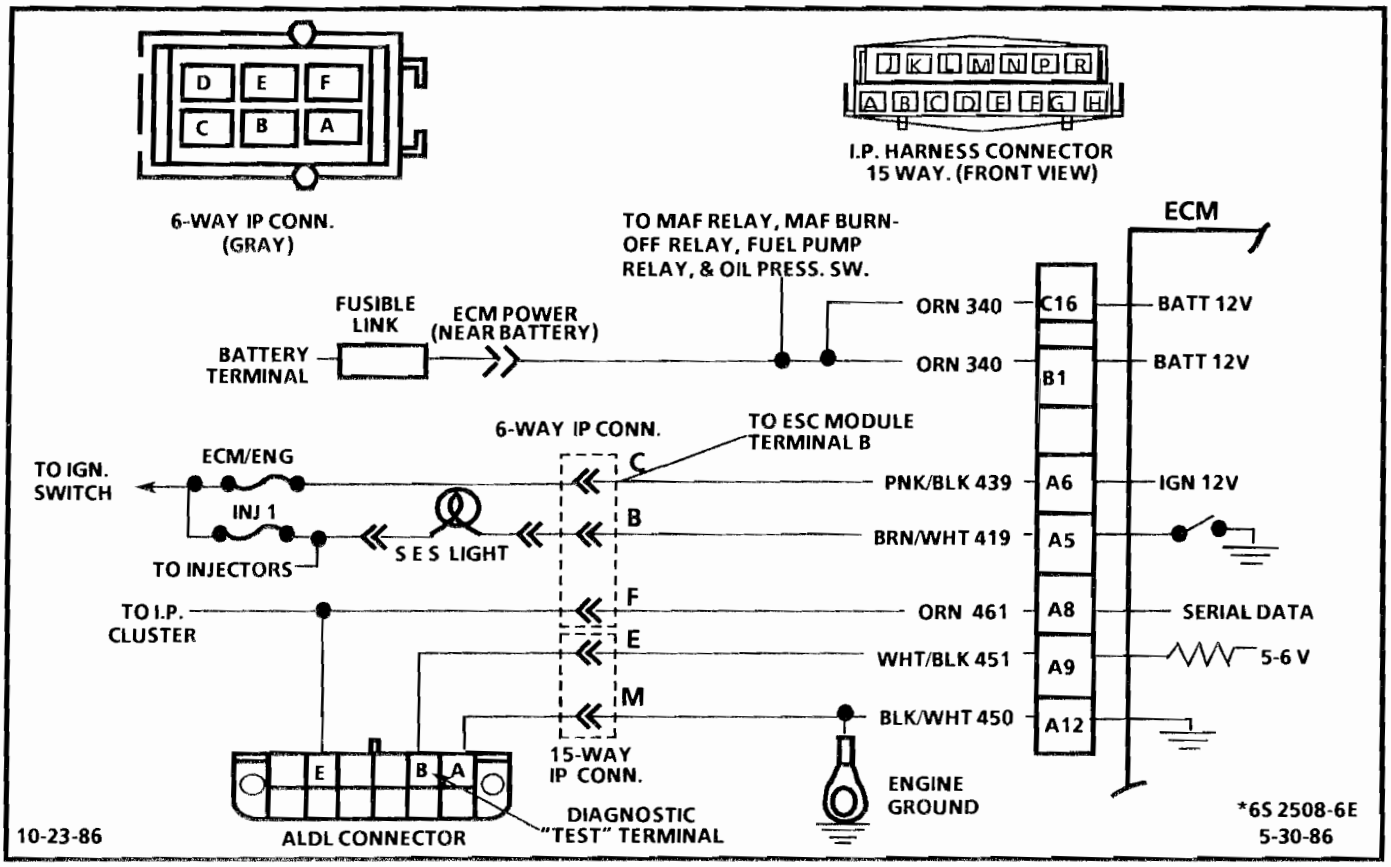


CHART A-1

NO "SERVICE ENGINE SOON" LIGHT
5.7L "Y" SERIES (PORT)

Circuit Description:

There should always be a steady "Service Engine Soon" Light when the ignition is "ON" and engine stopped. Battery is supplied directly to the light bulb. The Electronic Control Module (ECM) will control the light and turn it "ON" by providing a ground path through CKT 419 to the ECM.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. This test will determine if the ECM has the ability to ground CKT 419.
2. If both the continuous battery supply voltages are lost at terminals B1 and C16 or the ignition feed to terminal "A6" is not present, the "Service Engine Soon" light will not come "ON" with the ignition "ON".

Diagnostic Aids:

Engine runs OK, check:

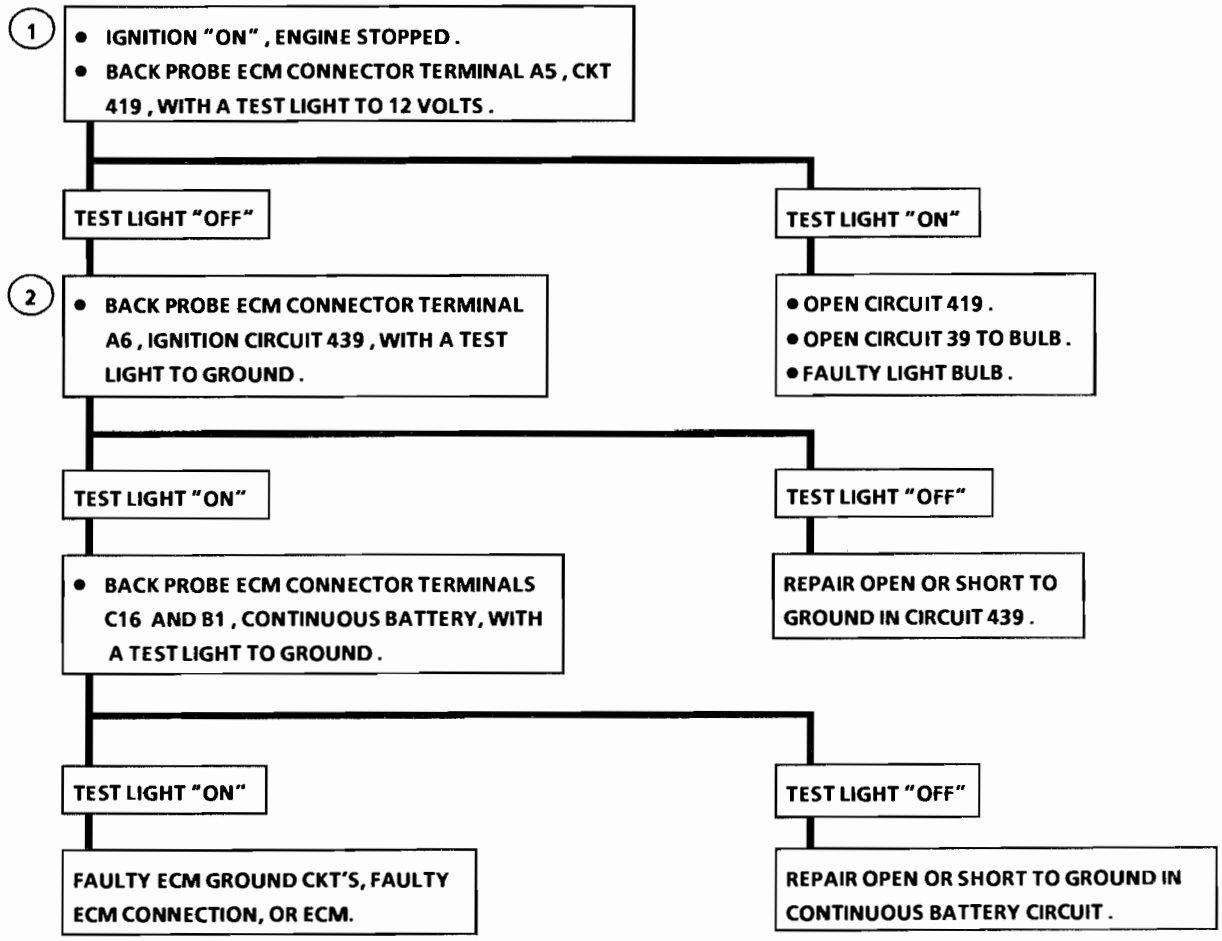
- Faulty light bulb.
- CKT 419 open.

Engine cranks but will not run.

- Continuous battery - fusible link open.
- ECM fuse open.
- Battery CKT 340 to ECM open.
- Ignition CKT 439 to ECM open.
- Poor connection to ECM.
- Faulty ECM ground circuit(s).

CHART A-1

NO "SERVICE ENGINE SOON" LIGHT 5.7L "Y" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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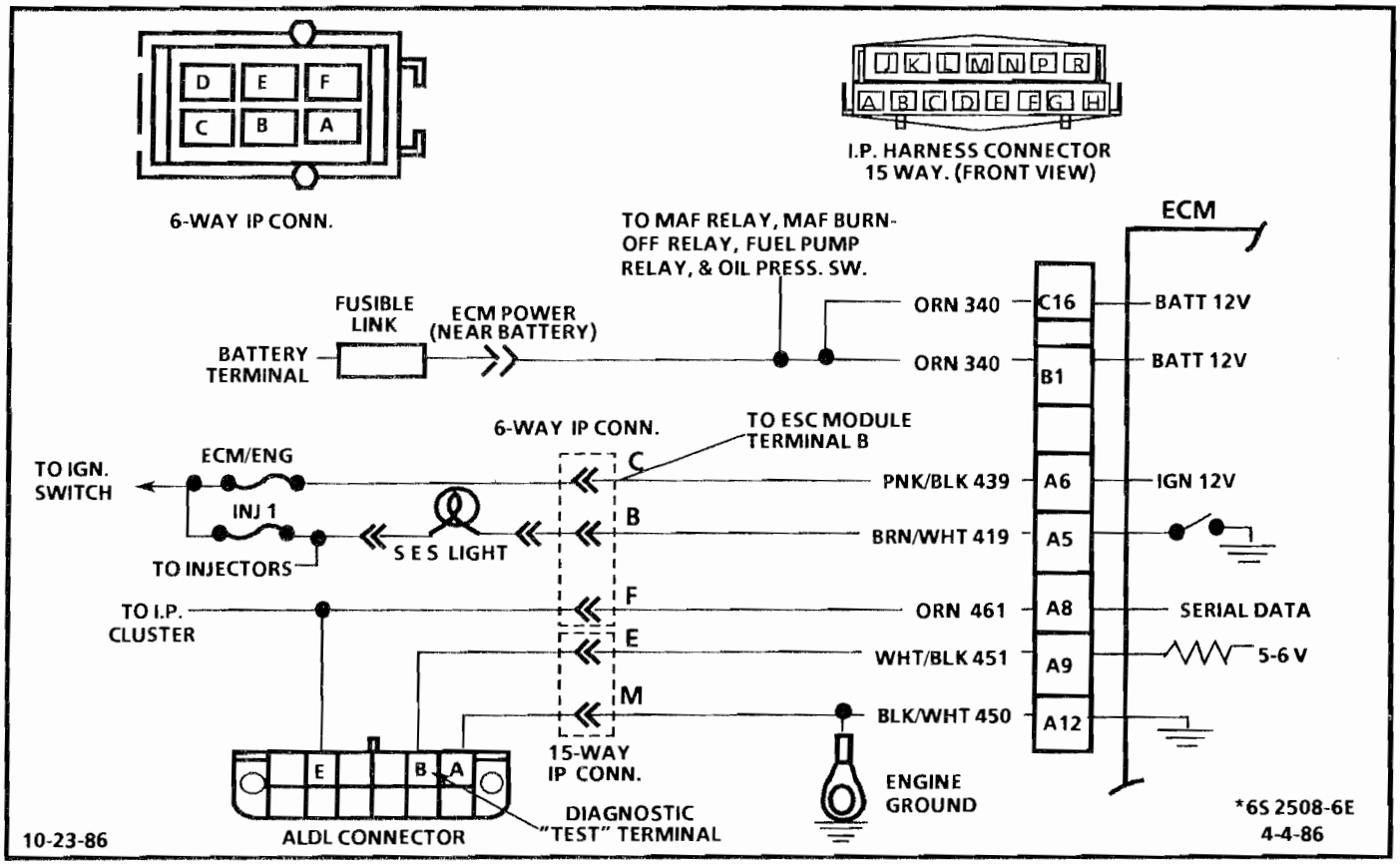


CHART A-2

NO ALDL DATA OR WON'T FLASH CODE 12
"SERVICE ENGINE SOON" LIGHT ON STEADY"
5.7L "Y" SERIES (PORT)

Circuit Description:

There should always be a steady "Service Engine Soon" Light when the ignition is "ON" and engine stopped. Battery ignition voltage is supplied to the light bulb. The Electronic Control Module (ECM) will turn the light "ON" by grounding CKT 419 at the ECM.

With the diagnostic terminal grounded, the light should flash a Code 12, followed by any trouble code(s) stored in memory.

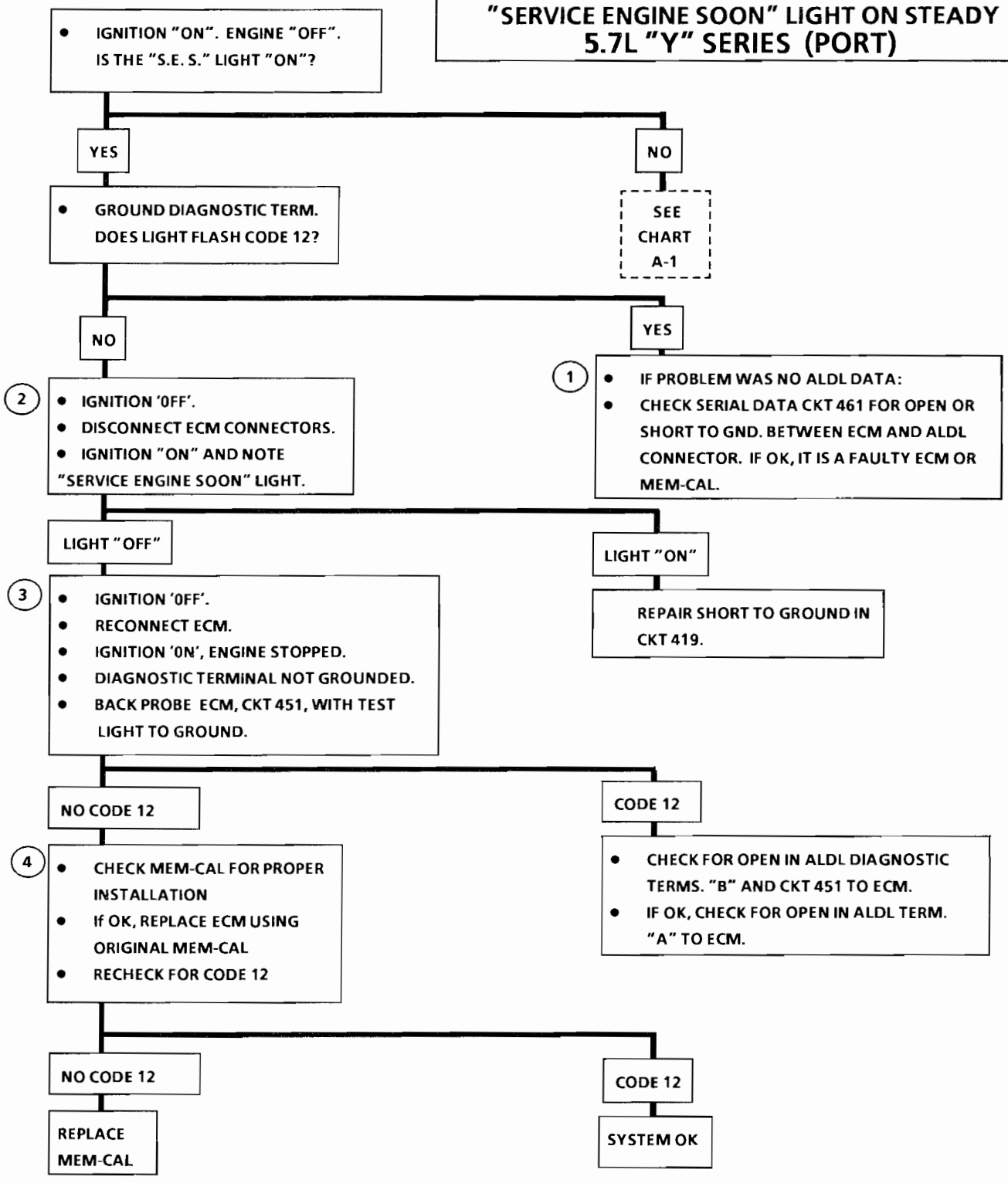
A steady light suggests a short to ground in the light control CKT 419, or an open in diagnostic CKT 451.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. If there is a problem with the ECM that causes a "Scan" tool to not read Serial data, the ECM should not flash a Code 12. If Code 12 is flashing check CKT 451 for short to ground. If Code 12 does flash, be sure that the "Scan" tool is working properly on another vehicle. If the "Scan" is functioning properly and CKT 461 is OK, the Mem-Cal or ECM may be at fault for the NO ALDL symptom. Also, be sure CKT 461 is OK going to the instrument panel cluster.
2. If the light goes "OFF", when the ECM connector is disconnected, CKT 419 is not shorted to ground.
3. This step will check for an open diagnostic CKT 451.
4. At this point, the "Service Engine Soon" light wiring is OK. The problem is a faulty ECM or Mem-Cal. If Code 12 does not flash, the ECM should be replaced using the original Mem-Cal. Replace the Mem-Cal only after trying an ECM, as a defective Mem-Cal is an unlikely cause of the problem.

CHART A-2

NO ALDL DATA OR WON'T FLASH CODE 12
"SERVICE ENGINE SOON" LIGHT ON STEADY
5.7L "Y" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP " OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

3-26-86
7S 3186-6E

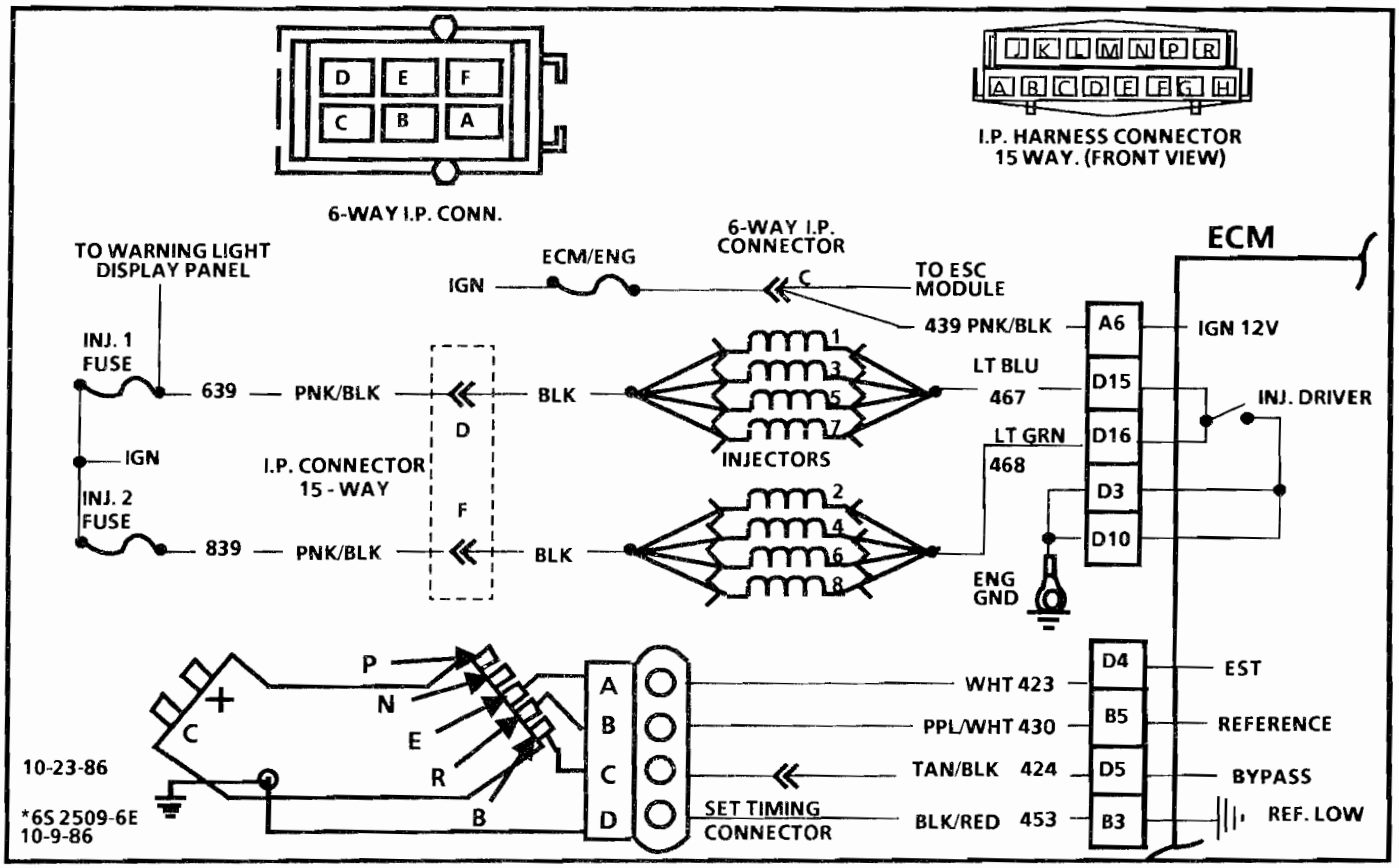


CHART A-3

(Page 1 of 2)
ENGINE CRANKS BUT WON'T RUN
5.7L "Y" SERIES (PORT)

Circuit Description:

This Chart assumes that battery condition and engine cranking speed are OK, and there is adequate fuel in the tank.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. A "Service Engine Soon" light "ON" is a basic test to determine if there is a 12 volt supply and ignition 12 volts to ECM. No ALDL may be due to an ECM problem and CHART A-2 will diagnose the ECM. If TPS is over 2.5 volts, the engine may be in the clear flood mode, which will cause starting problems. The engine will not start without reference pulses and, therefore, the "Scan" should read rpm (reference) during crank.
2. No spark may be caused by one of several components related to the Ignition System. Chart C-4 will address all problems related to the causes of a no spark condition.
3. The test light should blink, indicating the ECM is controlling the injectors OK. How bright the light blinks is not important. However, the test light should be a J-34730-3 or equivalent.
4. Use fuel pressure gage J-34730-1 or equivalent. Wrap a shop towel around the fuel pressure tap to absorb any small amount of fuel leakage that may occur when installing the gage.

Diagnostic Aids:

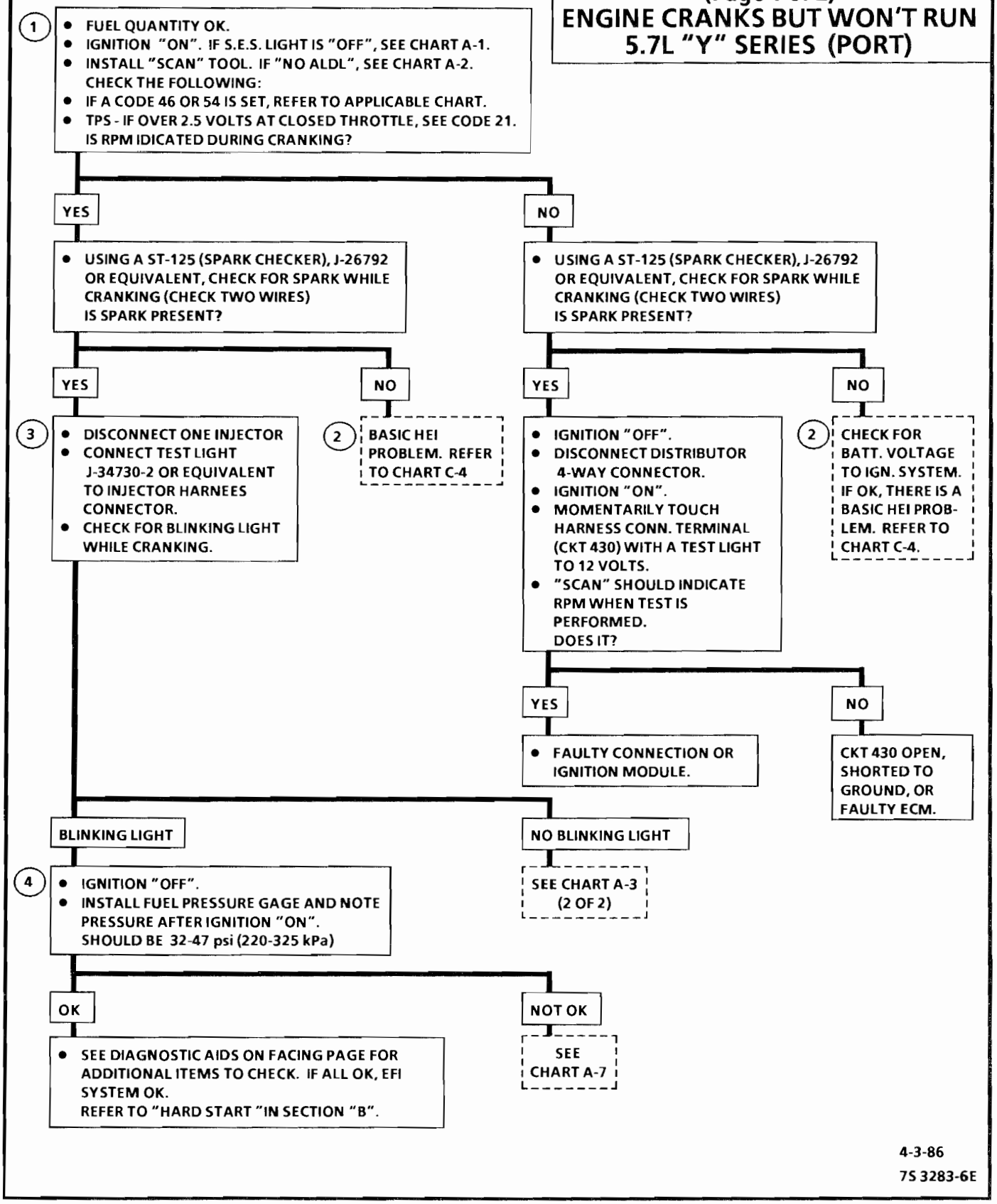
- An EGR valve sticking open can cause a low air/fuel ratio during cranking. Unless engine enters clear flood at the first indication of a flooding condition, it can result in a no start.
- Check for fouled plugs.
- A defective cold start circuit or water in fuel line can cause a no start in cold weather. See CHART A-9.
- A defective MAF Sensor may cause a no start or a stall after start. To determine if the sensor is causing the problem, disconnect it. The ECM will then use a default value for the sensor, and if the condition is corrected and the connections are OK, replace the sensor.
- Also check that injectors on both sides of engine will cause a test light to "blink". If not OK, check injector fuses.

If above are all OK, refer to Symptoms in Section "B", Hard Start.

CHART A-3

(Page 1 of 2)

ENGINE CRANKS BUT WON'T RUN 5.7L "Y" SERIES (PORT)



4-3-86

7S 3283-6E

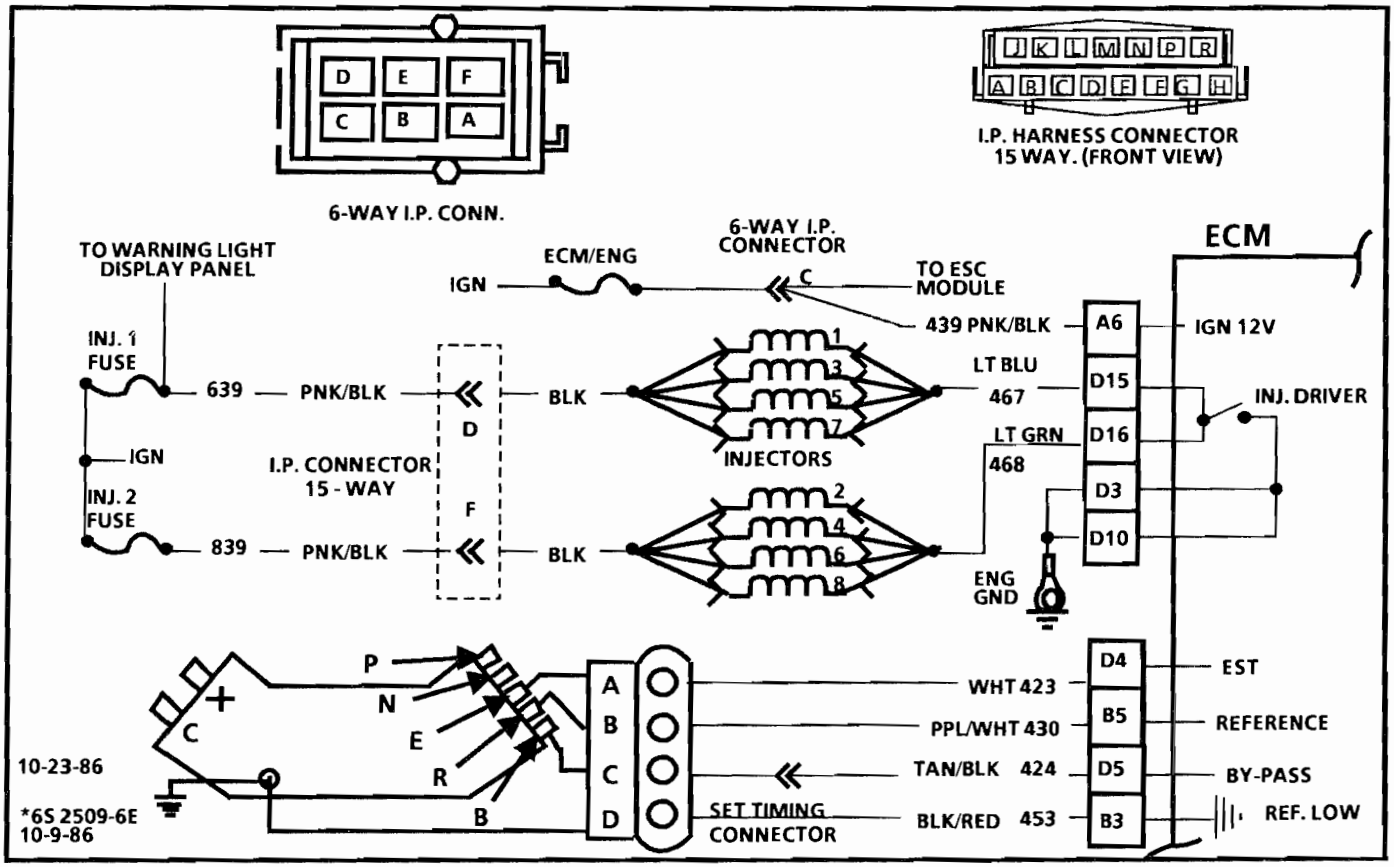


CHART A-3

(Page 2 of 2)
ENGINE CRANKS BUT WON'T RUN
5.7L "Y" SERIES (PORT)

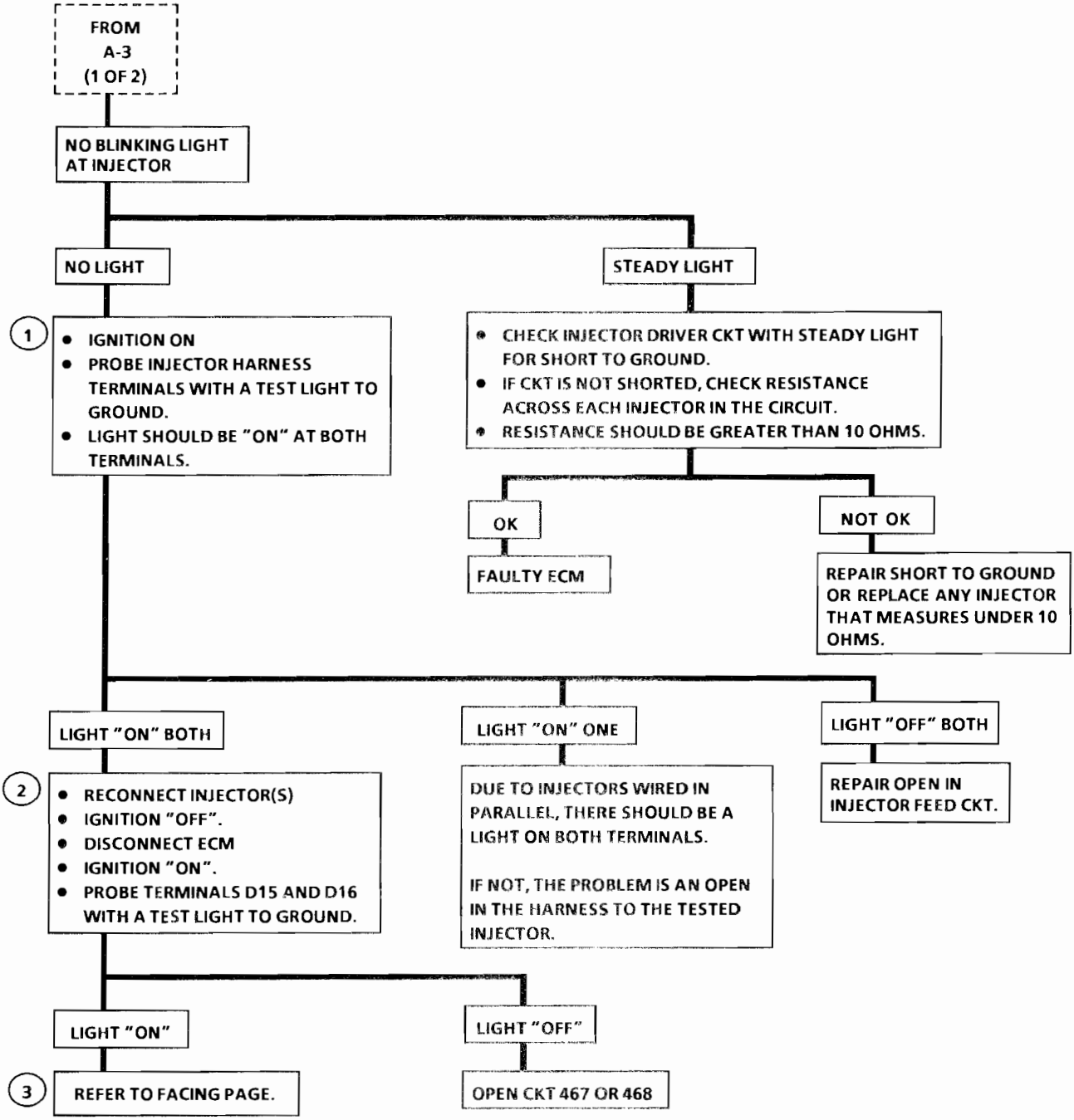
Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Checks for 12 volt supply to injectors. Due to the injectors wired in parallel there should be a light "ON" on both terminals.
2. Checks continuity of CKTs 467 and 468.
3. All checks made to this point would indicate that the ECM is at fault. However, there is a possibility of CKT 467 or 468 being shorted to a voltage source either in the engine harness or in the injector harness.
   - To test for this condition:
     - Disconnect all injectors
     - Ignition "ON".
     - Probe CKTs 467 and 468 on the ECM side of injector harness with a test light connected to ground. (Test one injector harness on each side of engine). There should be no light. If light is "ON" repair short to voltage.
     - If OK, check the resistance of the injectors.
     - Should be 10 ohms or more.
     - Check injector harness connector. Be sure terminals are not backed out of connector and contacting each other.
     - If all OK, replace ECM.

CHART A-3

(Page 2 of 2)

ENGINE CRANKS BUT WON'T RUN 5.7L "Y" SERIES (PORT)



4-24-86
* 7S 3284-6E

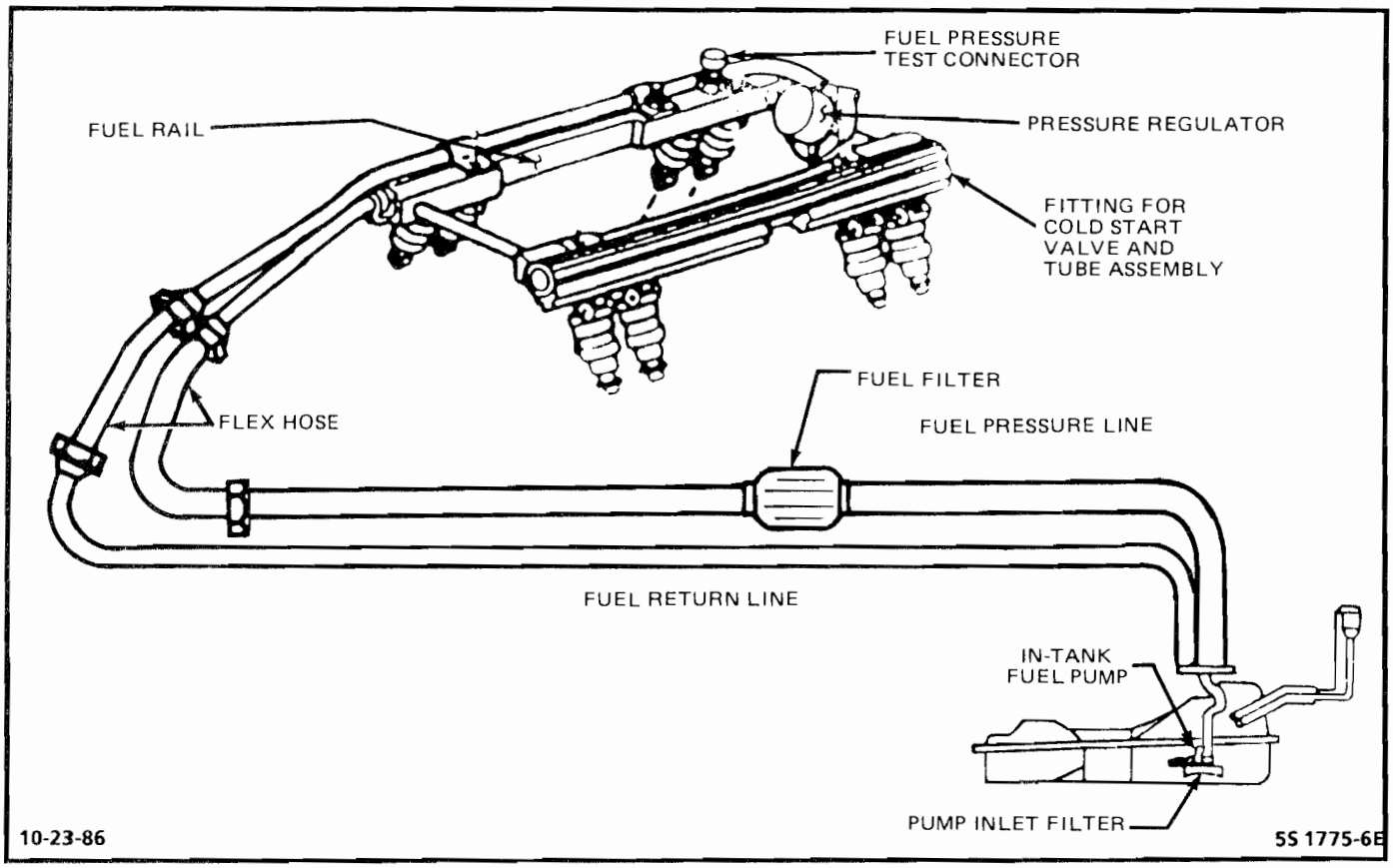


CHART A-7 (Page 1 of2)

FUEL SYSTEM DIAGNOSIS
5.7L "Y" SERIES (PORT)

Circuit Description:

When the ignition switch is turned "ON", the Electronic Control Module (ECM) will turn "ON" the in-tank fuel pump. It will remain "ON" as long as the engine is cranking or running, and the ECM is receiving reference pulses. If there are no reference pulses, the ECM will shut "OFF" the fuel pump within 2 seconds after ignition "ON" or engine stops.

The pump will deliver fuel to the fuel rail and injectors, then to the pressure regulator, where the system pressure is controlled to about 234 to 325 KPa (34 to 47 psi). Excess fuel is then returned to the fuel tank.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Wrap a shop towel around the fuel pressure connector to absorb any small amount of fuel leakage that may occur when installing the gage. Ignition "ON" pump pressure should be 280-325 KPa (40.5-47 psi). This pressure is controlled by spring pressure within the regulator assembly.
2. When the engine is idling, the manifold pressure is low (high vacuum) and is applied to the fuel regulator diaphragm. This will offset the spring and result in a lower fuel pressure.This idle pressure will vary somewhat depending on barometric pressure, however, the pressure idling should be less indicating pressure regulator control.
3. Pressure that continues to fall is caused by one of the following:
   - In-tank fuel pump check valve not holding.
   - Pump coupling hose or pulsator leaking.
   - Fuel pressure regulator valve leaking.
   - Injector(s) sticking open.
4. An injector sticking open can best be determined by checking for a fouled or saturated spark plug(s). If a leaking injector can not be determined by a fouled or saturated spark plug, the following procedure should be used.
   - Remove Plenum, and remove fuel rail bolts. Follow the procedures in the Fuel Control Section of this manual, but leave fuel lines connected.
   - Lift fuel rail out just enough to leave injector nozzles in the ports.

CAUTION: *BE SURE INJECTOR(S) ARE NOT ALLOWED TO SPRAY ON ENGINE AND THAT INJECTOR RETAINING CLIPS ARE INTACT. THIS SHOULD BE CAREFULLY FOLLOWED TO PREVENT FUEL SPRAY ON ENGINE WHICH WOULD CAUSE A FIRE HAZARD.*

   - Pressurize the fuel system and observe injector nozzles.

CHART A-7

(Page 1 of 2)

FUEL SYSTEM DIAGNOSIS 5.7L "Y" SERIES (PORT)

FROM CHART A-3

THIS CHART ASSUMES THERE IS NO CODE 54

NOTE:
THE IGNITION MAY HAVE TO BE CYCLED "ON" MORE THAN ONCE TO OBTAIN MAXIMUM PRESSURE. ALSO, IT IS NORMAL FOR THE PRESSURE TO DROP SLIGHTLY WHEN THE PUMP STOPS.

(1)
- INSTALL FUEL PRESSURE GAGE, J-34730-1 OR EQUIVALENT.
- IGNITION 'OFF' FOR 10 SECONDS. A/C "OFF".
- IGNITION "ON". FUEL PUMP WILL RUN FOR ABOUT 2 SECONDS.
- NOTE FUEL PRESSURE, WITH PUMP RUNNING SHOULD BE 280-325 kPa (40.5-47 psi) AND HOLD STEADY WHEN PUMP STOPS.

OK

(2)
- START AND IDLE ENGINE AT NORMAL OPERATING TEMP.
- PRESSURE SHOULD BE LOWER BY 21-69 kPa (3-10 psi).

OK

NO TROUBLE FOUND. REVIEW SYMPTOMS SECTION "B".

NOT OK

- APPLY 10 INCHES OF VACUUM TO PRESSURE REGULATOR.
- FUEL PRESSURE SHOULD DROP 21-69 kPa (3-10 psi).

OK

REPAIR VACUUM SOURCE TO REGULATOR.

NOT OK

REPLACE REGULATOR ASSEMBLY

NOT OK

(3)

PRESSURE, BUT NOT HOLDING

- IGNITION "OFF" FOR 10 SECONDS.
- IGNITION "ON"
- BLOCK FUEL PRESSURE LINE BY PINCHING FLEX HOSE, PRESSURE SHOULD HOLD.

NOT HOLDING

- IGN "OFF" FOR 10 SEC.
- IGN "ON".
- BLOCK FUEL RETURN LINE BY PINCHING HOSE.
- RECHECK PRESSURE.

HOLDS

FAULTY FUEL PRESSURE REGULATOR.

PRESSURE, BUT LESS THAN 280 kPa (40.5 psi).

ABOVE 325 kPa (47 psi).

SEE CHART A-7 (2 of 2)

HOLDS

CHECK :
- LEAKING PUMP COUPLING HOSE OR PULSATOR.
- FAULTY IN-TANK PUMP.

NOT HOLDING

(4) LOCATE AND CORRECT LEAKING INJECTOR(S).

NO PRESSURE

- IGNITION "OFF".
- APPLY 12 VOLTS TO FUEL PUMP TEST TERMINAL.
- LISTEN FOR FUEL PUMP RUNNING.

PUMP RUNS

CHECK FOR :
- PLUGGED IN-LINE FILTER.
- PLUGGED PUMP INLET FILTER.
- RESTRICTED FUEL LINE.
- DISCONNECTED COUPLING HOSE OR PULSATOR.

IF OK

PUMP NOT RUNNING

CHECK FOR :
- OPEN WIRE IN CKT 120.
- OPEN PUMP GROUND CKT 150.

IF OK

REPLACE IN-TANK FUEL PUMP

4-22-86

SS 1626-6EA

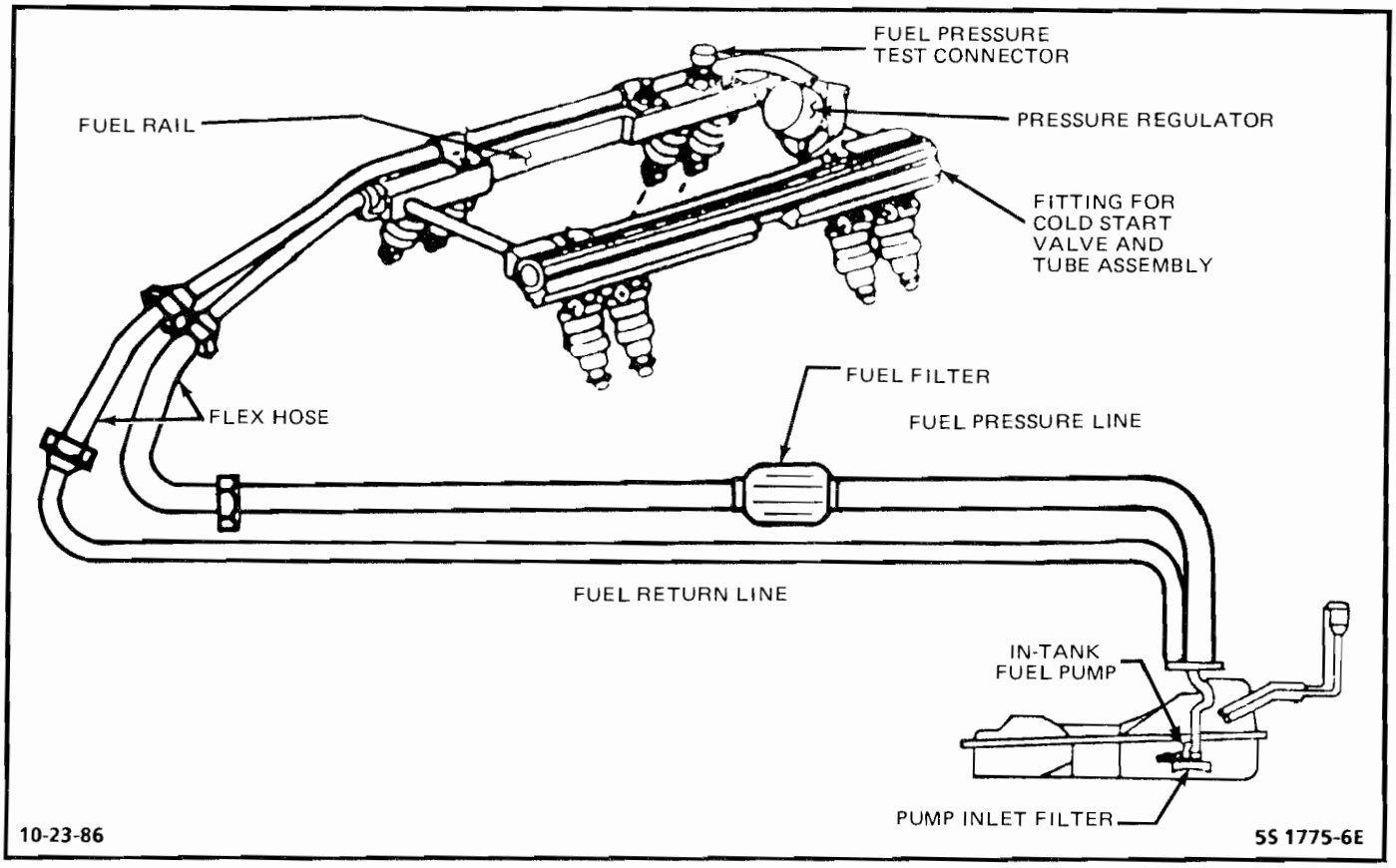


CHART A-7

(Page 2 of 2)
FUEL SYSTEM DIAGNOSIS
5.7L "Y" SERIES (PORT)

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Pressure but less than 280 kPa (40.5 psi) falls into two areas:
   - Regulated pressure but less than 280 kPa (40.5 psi). Amount of fuel to injectors OK but pressure is too low. System will be lean running and may set Code 44. Also, hard starting cold and overall poor performance.
   - Restricted flow causing pressure drop - Normally, a vehicle with a fuel pressure of less than 165 kPa (24 psi) at idle will not be driveable. However, if the pressure drop occurs only while driving, the engine will normally surge then stop running as pressure begins to drop rapidly. This is most likely caused by a restricted fuel line or plugged filter.
2. Restricting the fuel return line allows the fuel pump to develop its maximum pressure to the fuel rail. This will determine if the pressure regulator or the fuel pump is the cause of the low pressure condition. When battery voltage is applied to the pump test terminal, pressure should be above 414 kPa (60 psi).
3. This test determines if the high fuel pressure is due to a restricted fuel return line or a pressure regulator problem.

NOTICE: *FUEL SYSTEM UNDER PRESSURE. TO AVOID FUEL SPILLAGE, REFER TO FIELD SERVICE PROCEDURES FOR TESTING OR MAKING REPAIRS REQUIRING DISASSEMBLY OF FUEL LINES OR FITTINGS.*

CHART A-7

(Page 2 of 2)

FUEL SYSTEM DIAGNOSIS 5.7L "Y" SERIES (PORT)

FROM CHART A-7 (1 of 2)

(1) HAS PRESSURE BUT LESS THAN 280 kPa (40.5 psi).

- CHECK FOR RESTRICTED FUEL LINES OR IN-LINE FILTER.
  - OK
    - (2)
      - IGNITION "OFF".
      - BLOCK FUEL RETURN LINE.
      - APPLY 12 VOLTS TO FUEL PUMP RELAY HARNESS TERMINAL "A" OR FUEL PUMP TEST CONNECTOR AND NOTE PRESSURE.
      - ABOVE 325 kPa (47 psi). → FAULTY PRESSURE REGULATOR.
      - PRESSURE BUT LESS THAN 280 kPa (40.5 psi). → FAULTY IN-TANK
        - FUEL PUMP
        - COUPLING HOSE OR PULSATOR
        - INLET FILTER
        - WRONG FUEL PUMP
  - NOT OK → REPLACE FILTER OR REPAIR FUEL LINE AND RECHECK.

ABOVE 325 kPa (47 psi).

(3)
- DISCONNECT FUEL RETURN LINE FLEXIBLE HOSE.
- ATTACH $^{5}/_{16}$ I.D. FLEX HOSE TO PRESSURE REGULATOR SIDE OF RETURN LINE. INSERT THE OTHER END IN AN APPROVED GASOLINE CONTAINER.
  NOTE FUEL PRESSURE WITHIN 2 SECONDS AFTER IGNITION "ON".

- ABOVE 325 kPa (47 psi) → CHECK FOR RESTRICTED FUEL RETURN LINE FROM FUEL PRESSURE REGULATOR TO POINT WHERE FUEL LINE WAS DISCONNECTED. → IF LINE OK REPLACE FUEL PRESSURE REGULATOR.
- 280-325 kPa (40.5-47 psi) → LOCATE AND CORRECT RESTRICTED FUEL RETURN LINE TO FUEL TANK.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

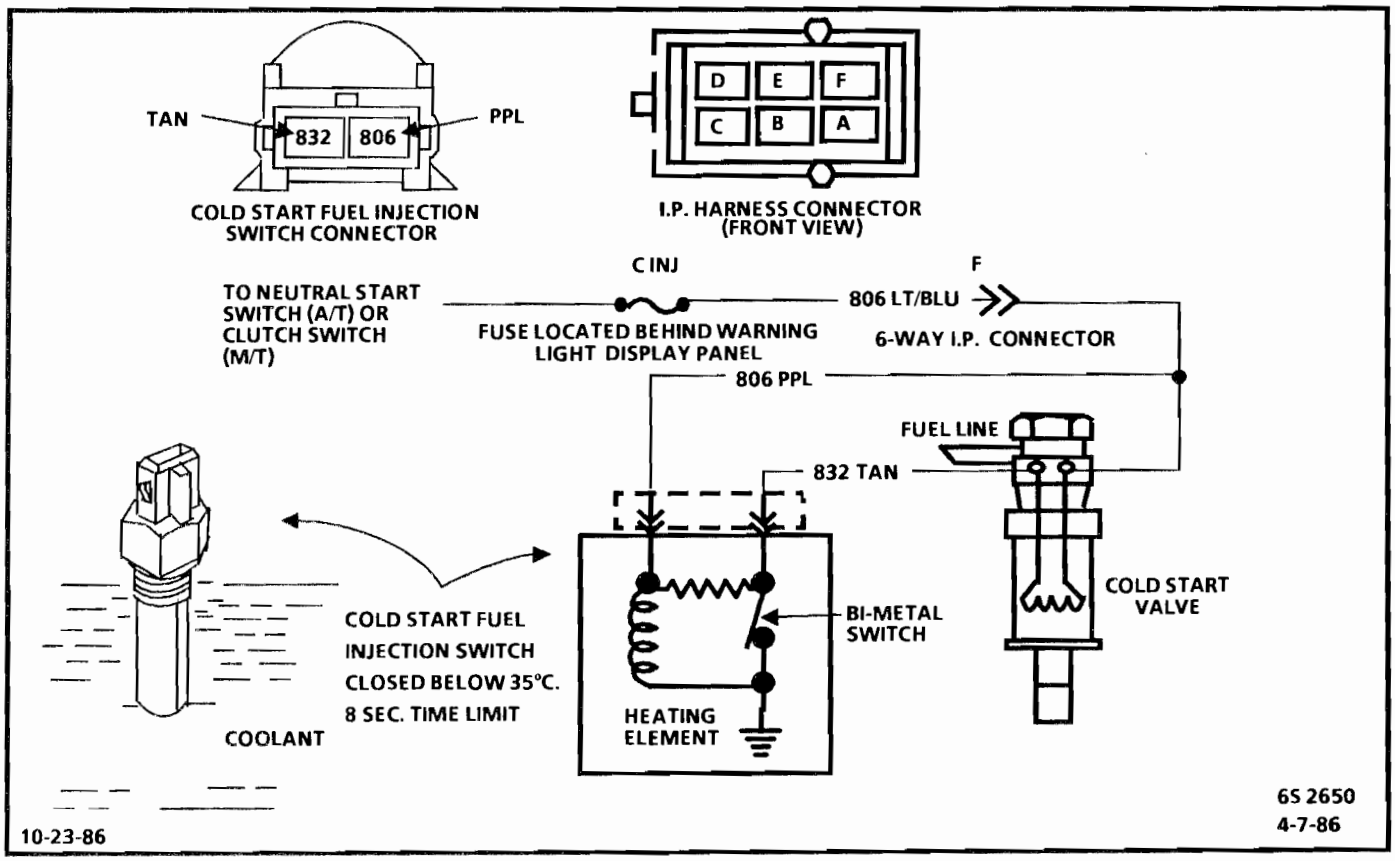


CHART A-9

COLD START VALVE CIRCUIT TEST 5.7L "Y" SERIES (PORT)

Circuit Description:

The cold start valve is used to provide additional fuel during the crank mode to improve cold start-ups. This circuit is important when engine coolant temperature is low because the other injectors are not pulsed "ON" long enough to provide the needed amount of fuel to start.

The circuit is activated only in the crank mode. The power is supplied directly from the starter solenoid and is protected by a fuse. The system is controlled by a cold start fuel injection switch which provides a ground path for the valve during cranking when engine coolant is below 35°C (95°F).

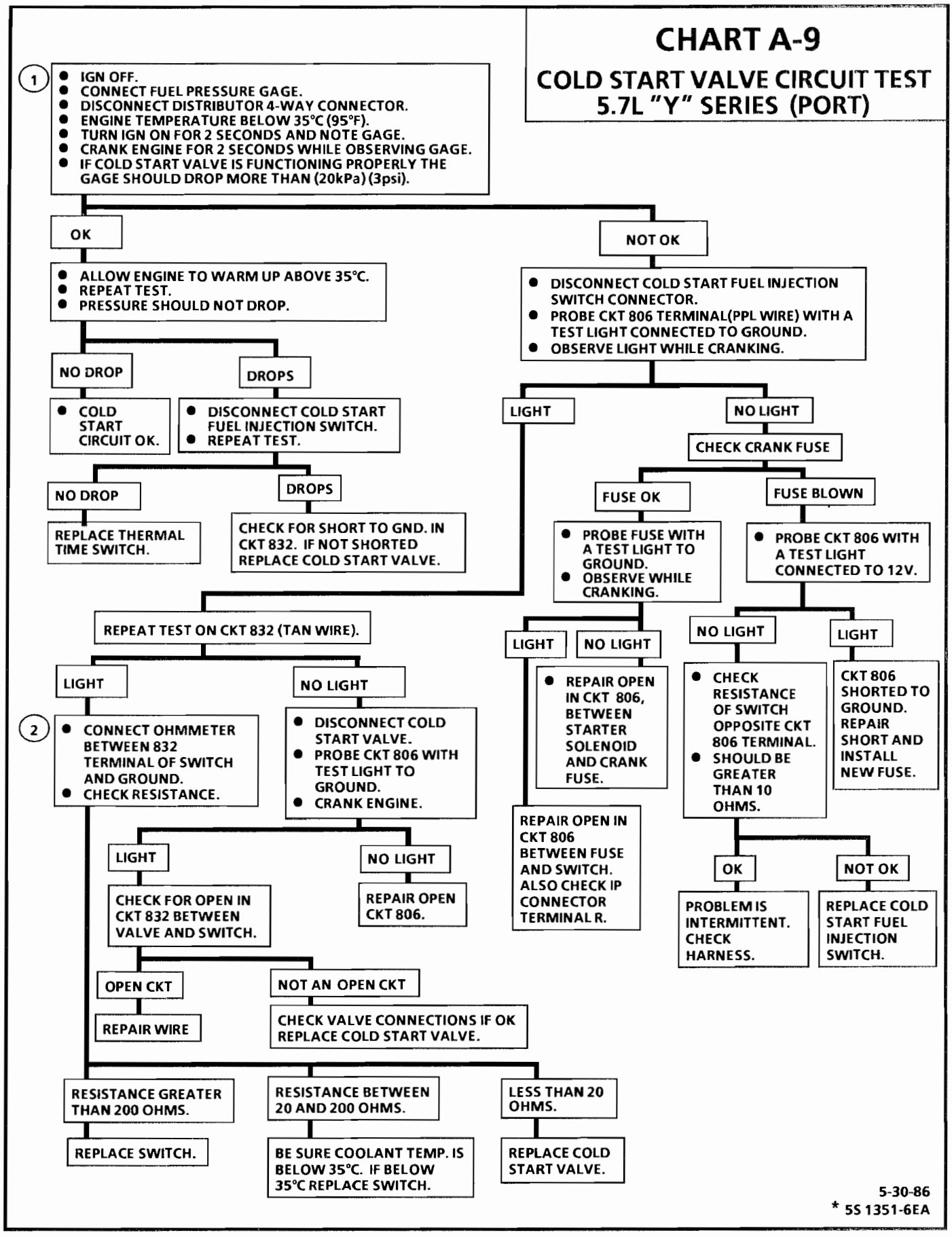
The cold start fuel injection switch consists of a bimetal material which opens at a specified coolant temperature. This bimetal is also heated by the winding in the thermal switch, which allows the valve to stay "ON" for 8 seconds at -20°C (-4°F) coolant. The time the switch will stay closed varies inversely with coolant temperature. In other words, as the coolant temperature goes up, the cold start valve "ON" time goes down.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Disconnecting the distributor 4-way connector will disable the other injectors. The amount of pressure drop depends on the temperature of the engine. This test could also be performed by removing the two injector fuses.
2. This test will determine the continuity through the switch to ground.

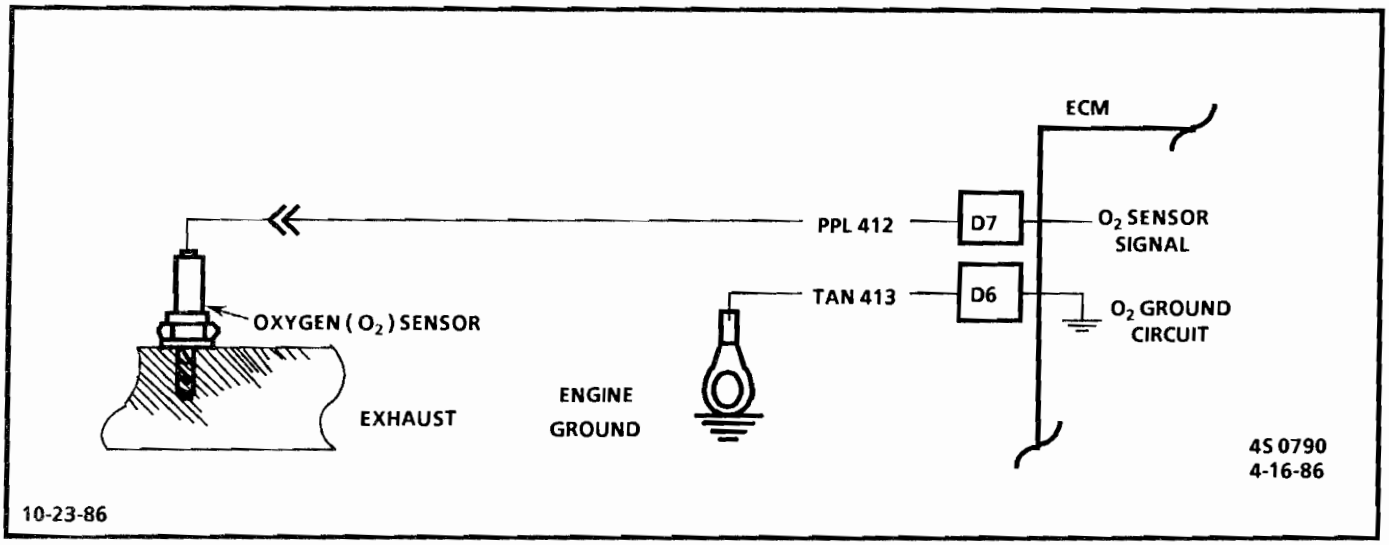
CHART A-9

COLD START VALVE CIRCUIT TEST 5.7L "Y" SERIES (PORT)



5-30-86

* 5S 1351-6EA



CODE 13

OXYGEN SENSOR CIRCUIT (OPEN CIRCUIT) 5.7L "Y" SERIES (PORT)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D7" and "D6". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360° C (600°F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Code 13 WILL SET:
   - Engine at normal operating temperature (above 70°C)
   - At least 2 minutes engine time after start.
   - O_2 signal voltage steady between .35 and .55 volts.
   - Throttle position sensor signal above 5%. (about .3 volts above closed throttle voltage)
   - All conditions must be met for about 60 seconds.

   If the conditions for a Code 13 exist, the system will not go "Closed Loop".
2. This will determine if the sensor is at fault or the wiring or ECM is the cause of the Code 13.
3 In doing this test use only a high impedence digital voltohm meter. This test checks the continuity of CKTs 412 and 413. If CKT 413 is open, the ECM voltage on CKT 412 will be over .6 volts (600 mv).

Diagnostic Aids:

Normal "Scan" voltage varies between 100 mv to 999mv (.1 and 1.0 volt), while in "Closed Loop". Code 13 sets in one minute, if voltage remains between .35 and .55 volts, but the system will go "Open Loop" in about 15 seconds.

Refer to Intermittents in Section "B".

"*SCAN*" DIAGNOSTICS

CODE 13

OXYGEN SENSOR CIRCUIT (OPEN CIRCUIT) 5.7L "Y" SERIES (PORT)

(1) ENGINE AT NORMAL OPERATING TEMPERATURE (ABOVE 80°C).
- RUN ENGINE ABOVE 1200 RPM FOR TWO MINUTES.

DOES "SCAN" INDICATE CLOSED LOOP?

NO

(2)
- DISCONNECT O_2 SENSOR
- JUMPER HARNESS CKT 412 TO GROUND

"SCAN" SHOULD DISPLAY O_2 VOLTAGE BELOW .2 VOLTS (200 MV) WITH ENGINE RUNNING. DOES IT?

NO

(3)
- IGNITION "ON", ENGINE "OFF".
- CHECK VOLTAGE OF CKT 412 AT O_2 SENSOR HARNESS CONNECTOR USING A DVM.

IT SHOULD BE .3-.6V (300 - 600MV).

.3-.6 VOLTS (300 - 600 MV)

FAULTY ECM

OVER .6 VOLT (600 MV)

OPEN CKT. 413, FAULTY CONNECTION OR FAULTY ECM.

LESS THAN .3 VOLT (300 MV)

OPEN CKT. 412, FAULTY ECM CONNECTION OR ECM.

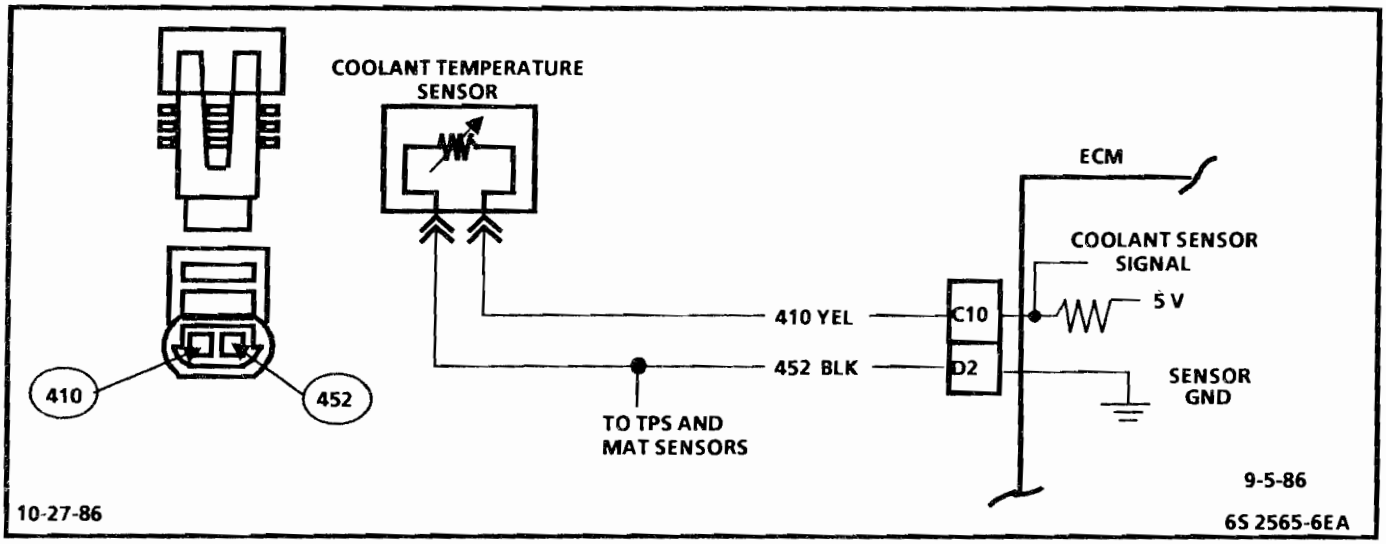
YES

FAULTY O^2 SENSOR CONNECTION OR SENSOR.

YES

CODE 13 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT (HIGH TEMPERATURE INDICATED) 5.7L "Y" SERIES (PORT)

Circuit Description:

The Coolant Temperature Sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine is cold, the sensor (thermistor) resistance is high, therefore, the ECM will see high signal voltage.

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C to 95°C) the voltage will measure about 1.5 to 2.0 volts.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Code 14 will set if:
   - Signal voltage indicates a coolant temperature above 130°C (266°F) for 3 seconds.
2. This test will determine if CKT 410 is shorted to ground, which will cause the condition for Code 14.

Diagnostic Aids:

Check harness routing for a potential short to ground in CKT 410.

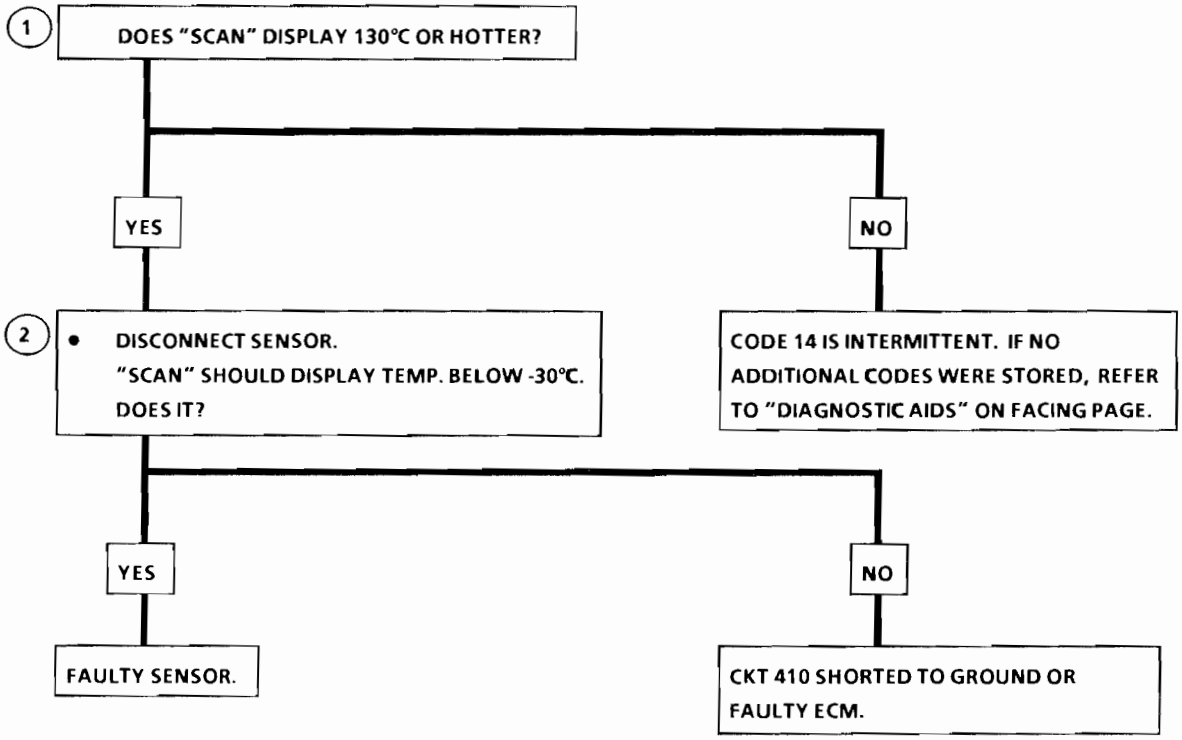
"Scan" tool displays engine temperature in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C, then stabilize when thermostat opens.

See "Intermittents" in Section "B".

"SCAN" DIAGNOSTICS

CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT (HIGH TEMPERATURE INDICATED) 5.7L "Y" SERIES (PORT)

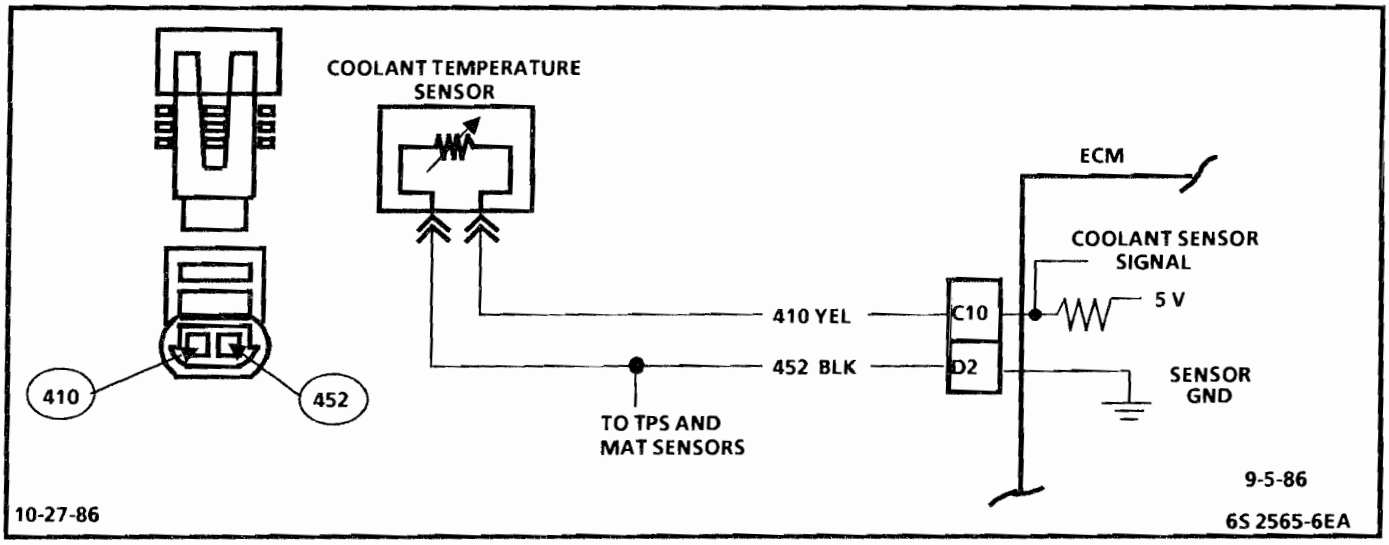


DIAGNOSTIC AID

COOLANT SENSOR		
TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)		
°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

9-10-86
• 7S 3055



CODE 15

COOLANT TEMPERATURE SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
5.7L "Y" SERIES (PORT)

Circuit Description:

The Coolant Temperature Sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine is cold, the sensor (thermistor) resistance is high, therefore the ECM will see high signal voltage.

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C to 95°C), the voltage will measure about 1.5 to 2.0 volts at the ECM.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Code 15 will set if:
   - Signal voltage indicates a coolant temperature less than -44°C (-47°F) for 3 seconds.
2. This test simulates a Code 14. If the ECM recognizes the low signal voltage, (high temp.) and the "Scan" reads 130°C or above, the ECM and wiring are OK
3. This test will determine if CKT 410 is open. There should be 5 volts present at sensor connector, if measured with a DVOM.

Diagnostic Aids:

A "Scan" tool reads engine temperature in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C, then stabilize when thermostat opens.

A faulty connection, or an open in CKT 410 or 452, will result in a Code 15.

If Code 22 or 23 is also set, check CKT 452 for faulty wiring or connections. Check terminals at sensor for good contact. Refer to "Intermittents" in Section "B".

"*SCAN*" DIAGNOSTICS

CODE 15

COOLANT TEMPERATURE SENSOR CIRCUIT (LOW TEMPERATURE INDICATED) 5.7L "Y" SERIES (PORT)

(1) DOES "SCAN" DISPLAY COOLANT -30°C OR COLDER?

YES

(2)
- DISCONNECT SENSOR
- JUMPER HARNESS TERMINALS TOGETHER "SCAN" SHOULD DISPLAY 130°C OR MORE. DOES IT?

YES

FAULTY CONNECTION OR SENSOR.

NO

(3)
- JUMPER CKT 410 TO GROUND. "SCAN" SHOULD DISPLAY OVER 130°C. DOES IT?

YES

OPEN SENSOR GROUND CIRCUIT, FAULTY CONNECTION OR FAULTY ECM.

NO

OPEN CKT 410, FAULTY CONNECTION AT ECM, OR FAULTY ECM.

NO

CODE 15 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

DIAGNOSTIC AID

COOLANT SENSOR

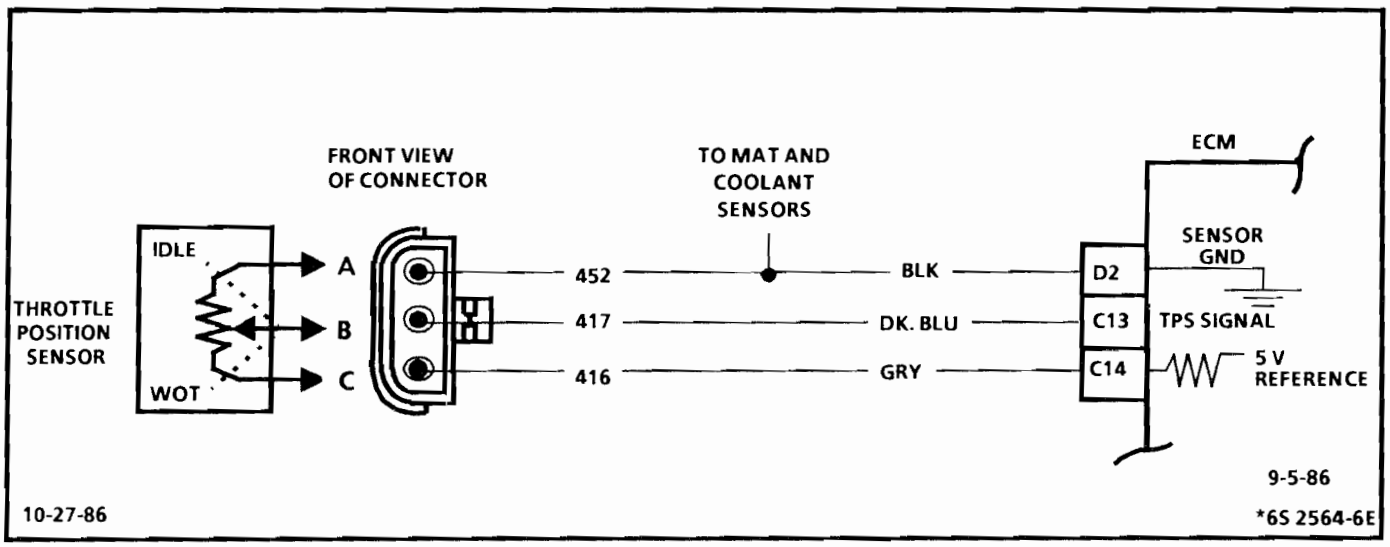
TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

9-11-86

• 7S 3261



CODE 21

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE HIGH)
5.7L "Y" SERIES (PORT)

Circuit Description:

The Throttle Position Sensor (TPS) provides a voltage signal that changes, relative to the throttle blade. Signal voltage will vary from about .5 at idle to about 5 volts at wide open throttle.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM control outputs.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. Code 21 will set if:
   - TPS signal voltage is greater than 2.5 volts.
   - Engine is running.
   - Air flow is less than 15 GM/sec.
   - All conditions met for 3 seconds.

   OR
   - TPS signal voltage over 4.5 volts with ignition "ON".

   With throttle closed the TPS should read less than .62 volts. If it doesn't, check adjustment.
2. With the TPS sensor disconnected, the TPS voltage should go low, if the ECM and wiring is OK.
3. Probing CKT 452 with a test light checks the 5 volt return CKT, because a faulty 5 volt return will cause a Code 21.

Diagnostic Aids:

A "Scan" tool reads throttle position in volts. Should read .54V ± .08V with throttle closed and ignition "ON" or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT.

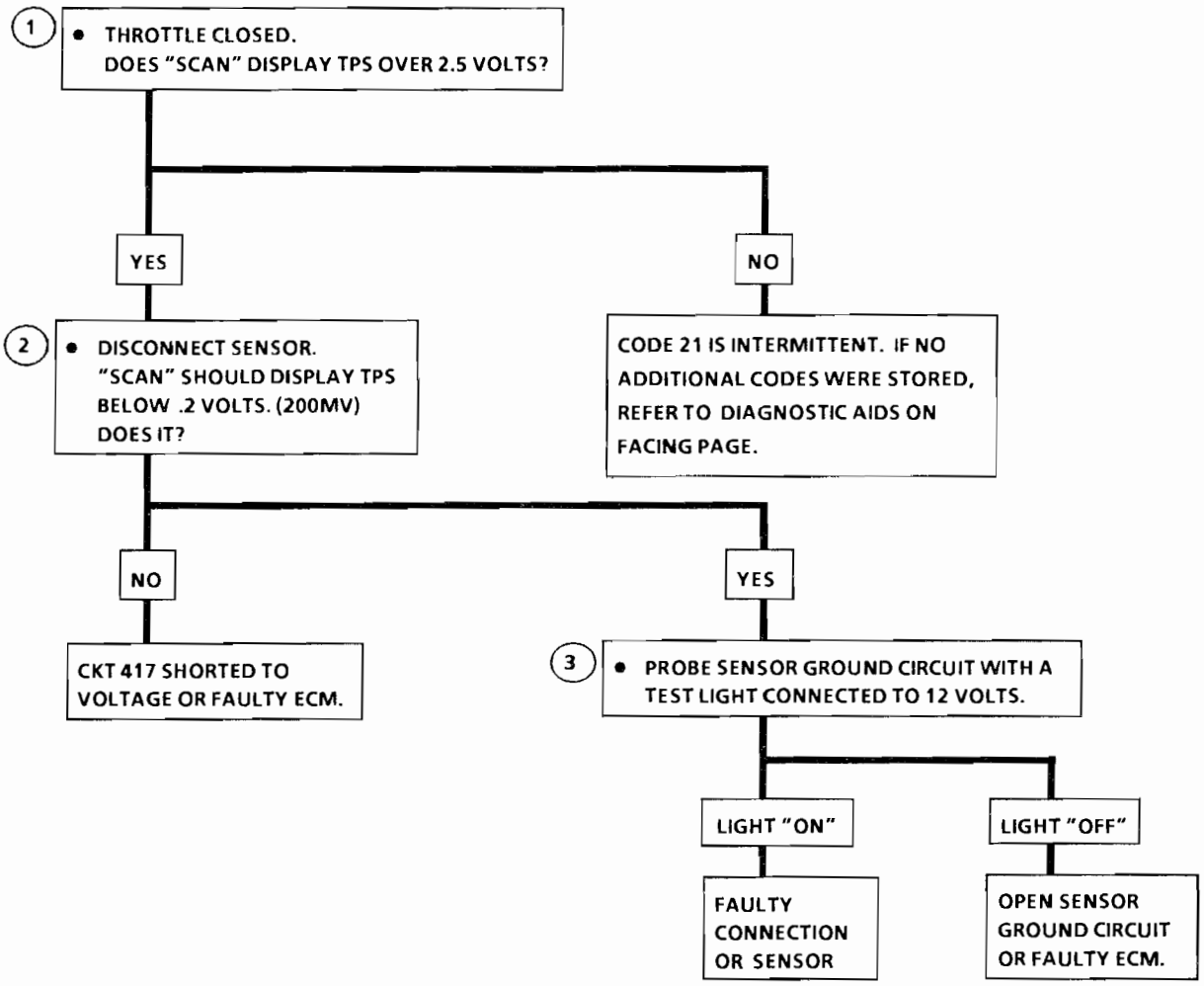
An open in CKT 452 will result in a Code 21.

Refer to "Intermittents" in Section "B".

"*SCAN*" DIAGNOSTICS

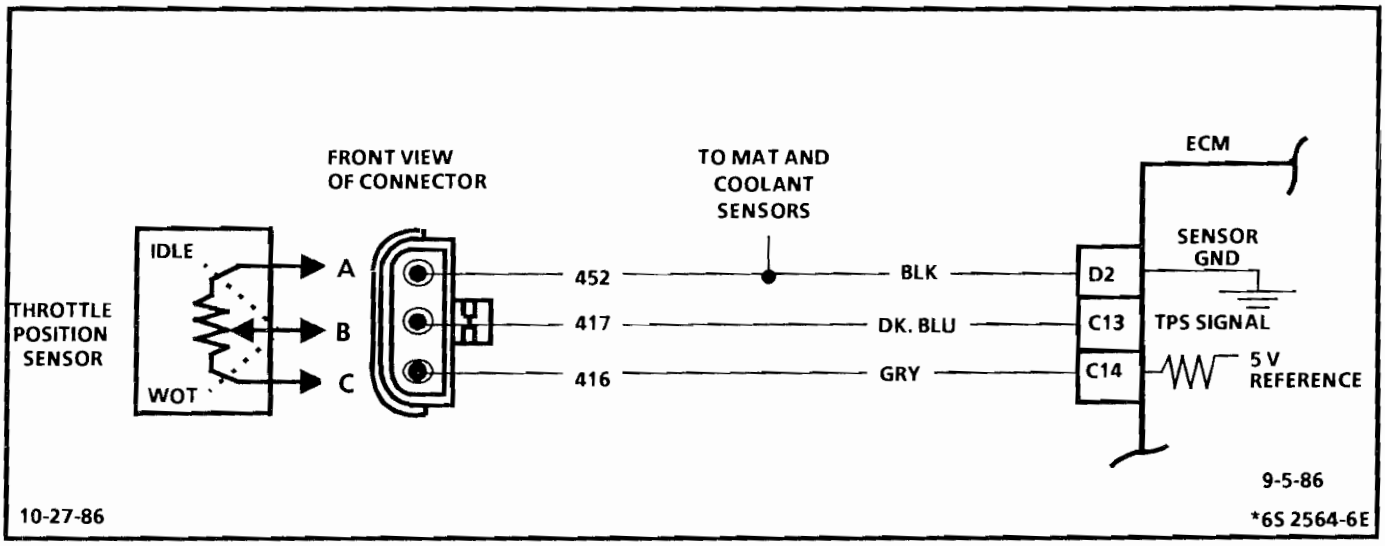
CODE 21

THROTTLE POSITION SENSOR (TPS) CIRCUIT (SIGNAL VOLTAGE HIGH) 5.7L "Y" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

9-10-86
• 7S 3057



CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE LOW)
5.7L "Y" SERIES (PORT)

Circuit Description:

The Throttle Position Sensor (TPS) provides a voltage signal that changes, relative to the throttle blade. Signal voltage will vary from about .5 at idle to about 5 volts at wide open throttle.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM control outputs.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. Code 22, will set if:
   - Engine running.
   - TPS signal voltage is less than about .2 volt for 3 seconds.
2. Simulates Code 21: (high voltage) If the ECM recognizes the high signal voltage, the ECM and wiring are OK.
3. Adjust TPS: With throttle closed, the TPS voltage reading should be .54V $\pm$ .08V. If TPS cannot be adjusted to specification, the TPS should be replaced.
4. This simulates a high signal voltage to check for an open in CKT 417.

Diagnostic Aids:

A "Scan" tool reads throttle position in volts. Should read .54V $\pm$ .08V with throttle closed and ignition on or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT.

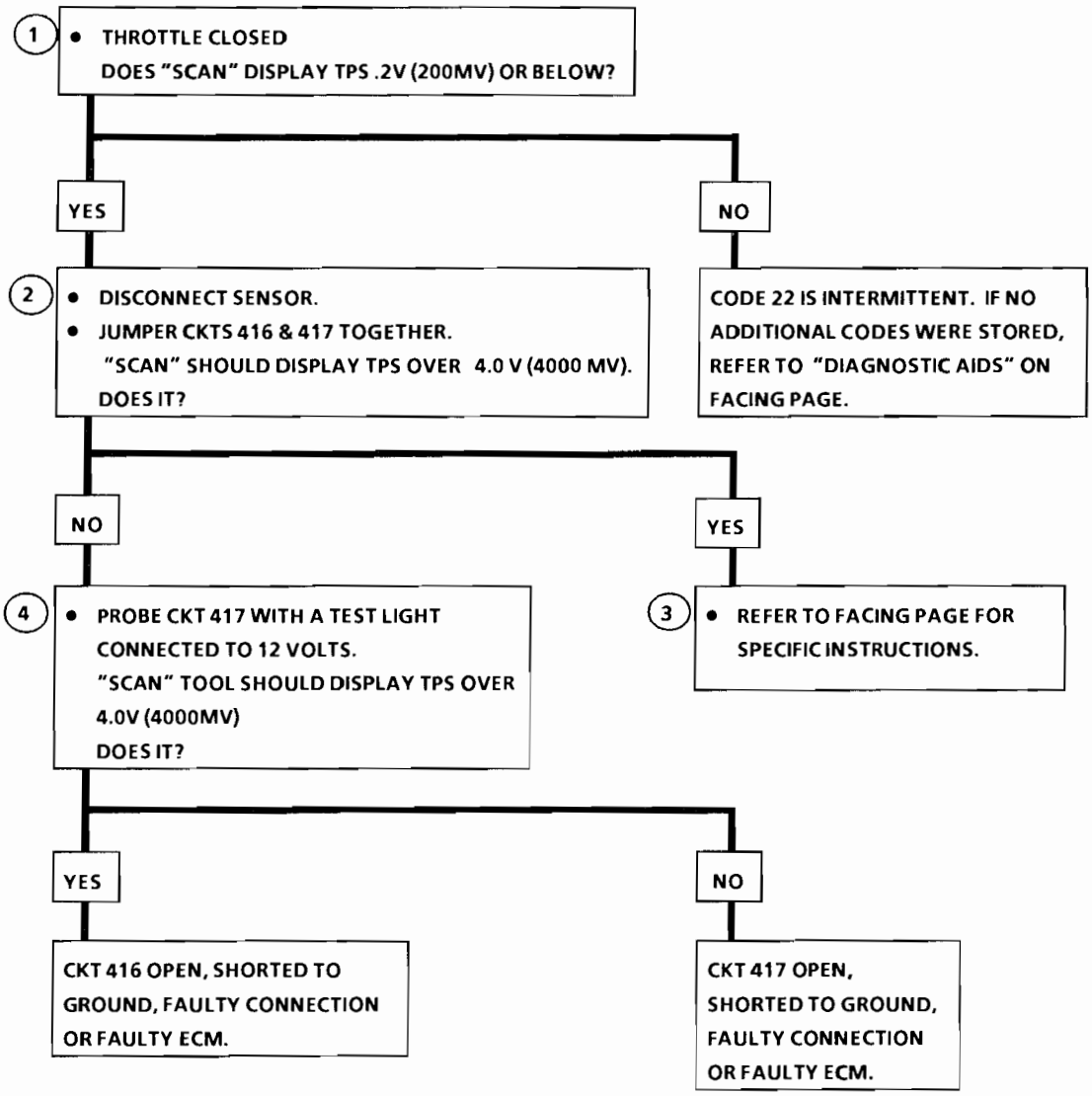
An open or short to ground in CKTs 416 or 417 will result in a Code 22.

Refer to Intermittents in Section "B".

"*SCAN*" DIAGNOSTICS

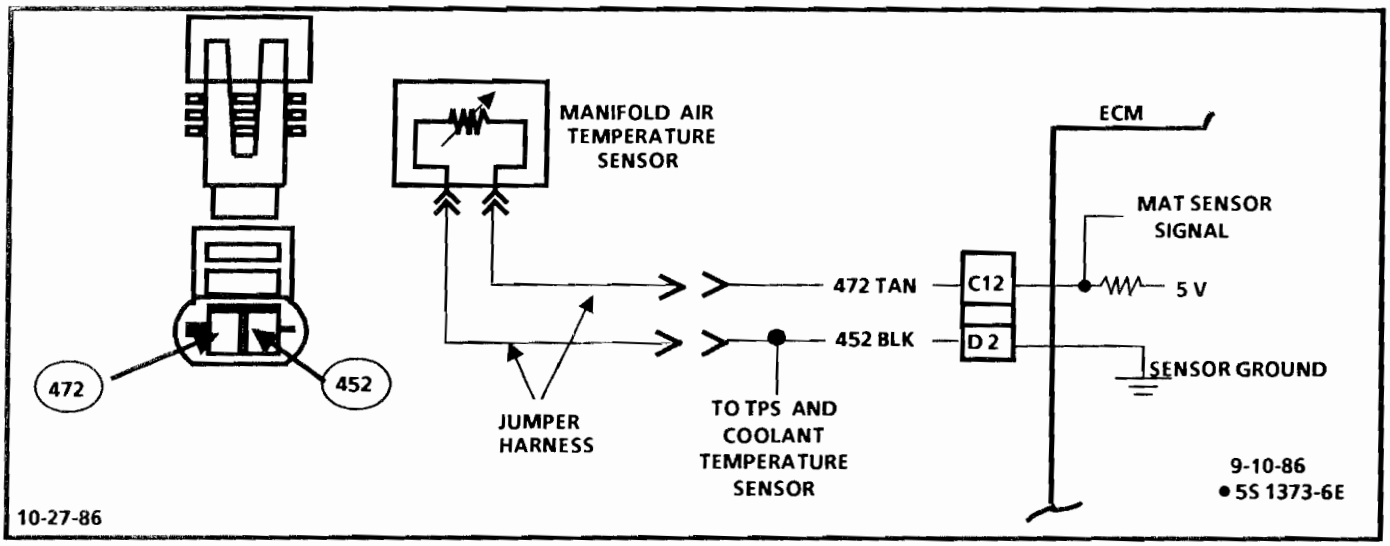
CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT (SIGNAL VOLTAGE LOW) 5.7L "Y" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

10-8-86
• 7S 3365



CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT (LOW TEMPERATURE INDICATED) 5.7L "Y" SERIES (PORT)

Circuit Description:

The MAT Sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage (about 5 volts) on CKT 472 to the sensor. When the air is cold, the sensor (thermistor) resistance is high, therefore, the ECM will see a high signal voltage. If the air is warm, the sensor resistance is low, therefore the ECM will see a low voltage.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Code 23 will set if:
   - A signal voltage indicates a manifold air temperature below −30°C (-22°F) for 12 seconds.
   - Time since engine start is 4 minutes or longer.
   - No VSS (vehicle not moving)
2. A Code 23 will set, due to an open sensor, wire, or connection. This test will determine if the wiring and ECM are OK. The MAT sensor is difficult to reach and this test can be performed by disconnecting the MAT jumper harness connector. If the "Scan" indicates a temperature of over 130°C, the jumper harness to the sensor should be checked before replacing the sensor.
3. This will determine if the signal CKT 472 or the sensor ground (CKT 452) is open.

Diagnostic Aids:

A "Scan" tool reads temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rises as underhood temperature increases.

Carefully check harness and connections for possible open CKT 472 or 452.

Refer to "Intermittents" in Section "B".

"SCAN" DIAGNOSTICS

CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT (LOW TEMPERATURE INDICATED) 5.7L "Y" SERIES (PORT)

1. • DOES "SCAN" TOOL DISPLAY MAT -30°C OR COLDER?

YES

2. • DISCONNECT SENSOR.
   • JUMPER HARNESS TERMINALS TOGETHER. "SCAN" SHOULD DISPLAY TEMPERATURE OVER 130°C. DOES IT?

YES

FAULTY CONNECTION OR SENSOR.

NO

3. • JUMPER CKT 472 TO GROUND. "SCAN" SHOULD DISPLAY TEMP. OVER 130°C. DOES IT?

YES

OPEN SENSOR GROUND CIRCUIT, FAULTY CONNECTION OR FAULTY ECM.

NO

OPEN CKT 472, FAULTY CONNECTION OR FAULTY ECM.

NO

CODE 23 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

DIAGNOSTIC AID

MAT SENSOR

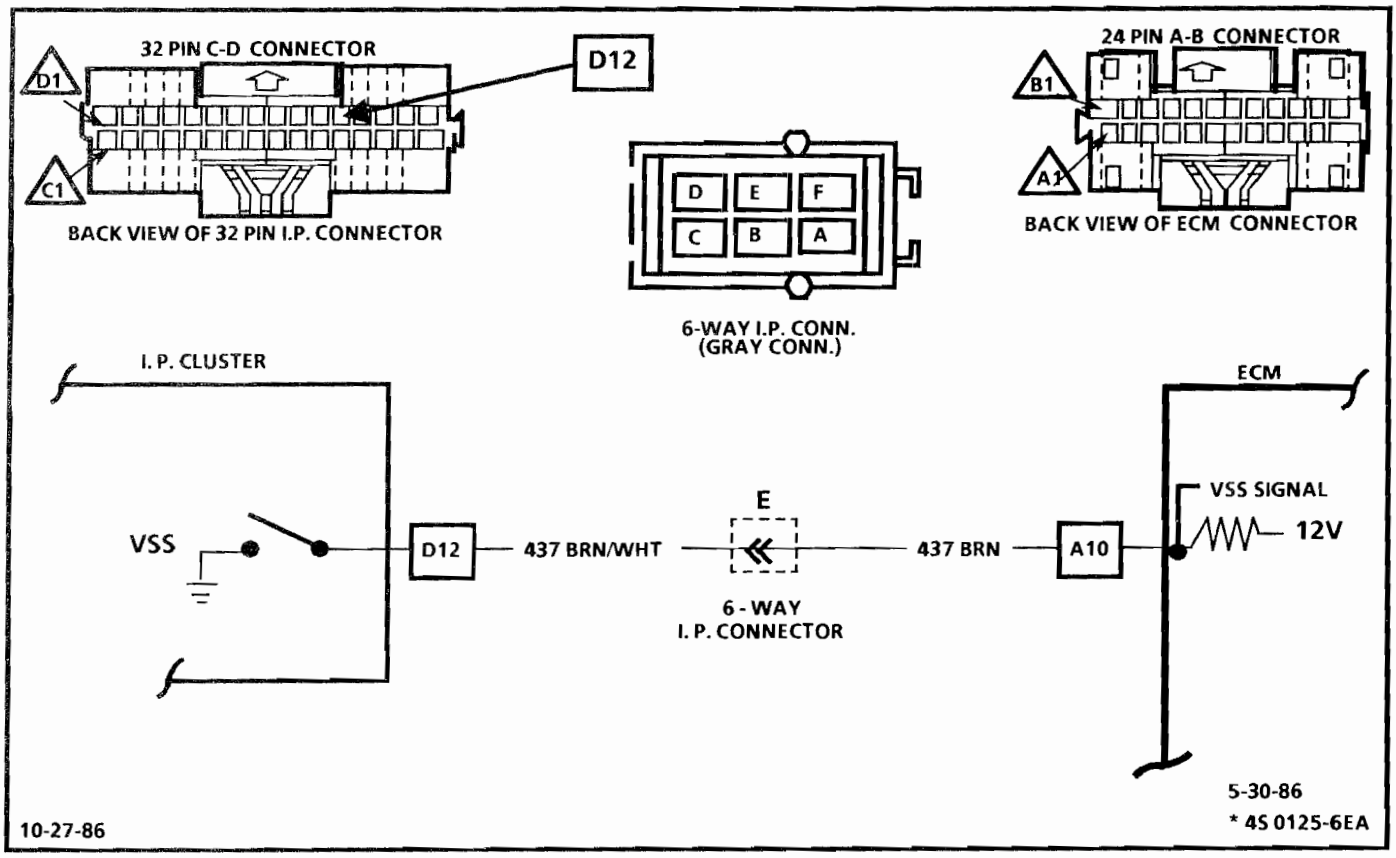
TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

10-3-86

• 7S 3285



CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT 5.7L "Y" SERIES (PORT)

Circuit Description:

The ECM applies and monitors 12 volts on CKT 437. CKT 437 connects to the I. P. Vehicle Speed Sensor, which alternately grounds CKT 437 when drive wheels are turning. This pulsing action takes place about 2000 times per mile and the ECM will calculate vehicle speed based on the time between "pulses". The I.P. cluster receives the vehicle speed signal from a P.M. generator mounted in the transmission.

A "Scan" tool reading should closely match with speedometer reading with drive wheels turning.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. Code 24 will set if:
   - CKT 437 voltage is constant.
   - Engine speed between 900 and 4400 rpm.
   - Closed throttle.
   - Low load condition (low air flow).
   - Not in park or neutral.
   - All conditions must be met for 2 seconds.

   These conditions are met during a road load deceleration.
2. A voltage of less than 1 volt at the 6-way connector indicates that the CKT 437 wire may be shorted to ground. Disconnect CKT 437 at the I.P. cluster. If voltage now reads above 10 volts, the I.P. cluster is faulty. If voltage remains less than 10 volts, then CKT 437 wire is grounded or open. If 437 is not grounded or open, check for a faulty ECM connector or ECM.

Diagnostic Aids:

If "Scan" displays vehicle speed, check park/neutral switch CHART C-1A on vehicle with auto trans. If switch is OK, check for intermittent connections. An open or short to ground in CKT 437 will result in a Code 24. If the customer also complained about a loss of mph on the I.P., check the P.M. generator circuit. Refer to Section "8A" for complete wiring diagram.

Refer to "Intermittents" in Section "B".

"SCAN" DIAGNOSTICS

CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT 5.7L "Y" SERIES (PORT)

DISREGARD CODE 24 IF SET WHILE DRIVE WHEELS ARE NOT TURNING.

(1)

- THIS CHART ASSUMES SPEEDOMETER IS WORKING OK. IF NOT REFER TO SECTION "8A".
- RAISE DRIVE WHEELS.
- WITH ENGINE IDLING IN GEAR, "SCAN" SHOULD DISPLAY MPH ABOVE 0.

DOES IT?

NO

(2)

- IGNITION "OFF".
- DISCONNECT I.P. CLUSTER
- IGNITION "ON."
- PROBE 6-WAY I.P. CONNECTOR TERMINAL "E" WITH VOLTMETER TO GROUND.
- SHOULD DISPLAY 10 VOLTS OR MORE.

DOES IT?

YES

CIRCUIT 437 OPEN BETWEEN I.P. 6-WAY CONNECTOR AND I.P. CLUSTER CONNECTOR OR FAULTY I.P. CLUSTER.

NO

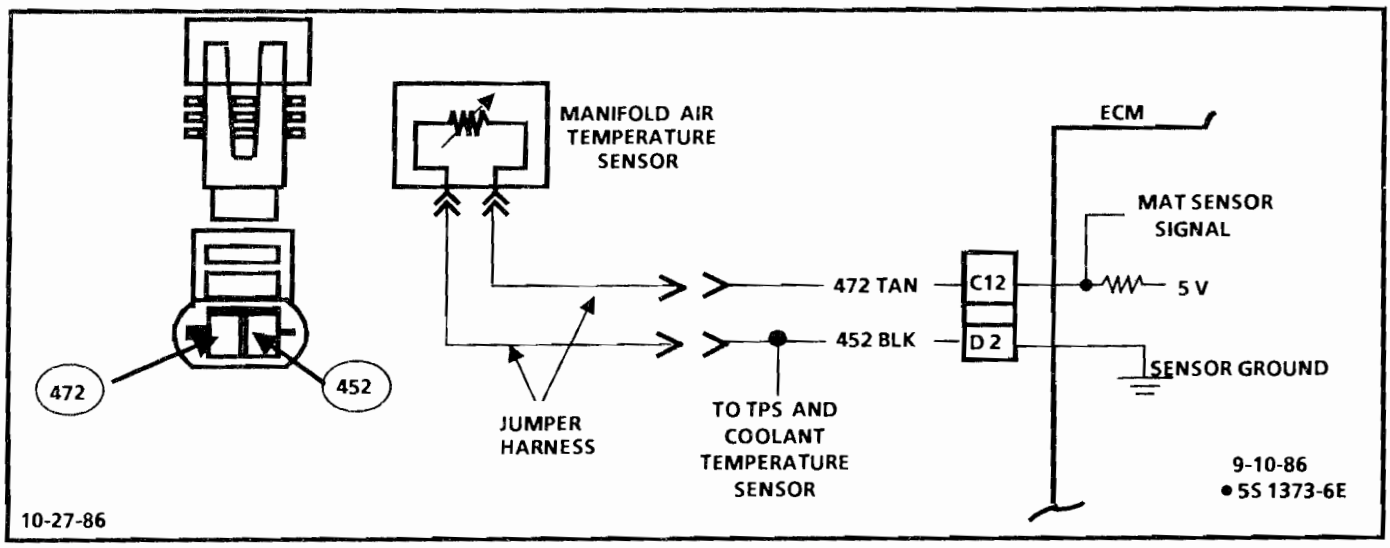
CIRCUIT 437 SHORTED TO GROUND, OPEN BETWEEN ECM AND I.P. 6-WAY CONNECTOR, OR FAULTY ECM.

YES

CODE 24 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP " OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

10-21-86
*7S 3324-6E



CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT (HIGH TEMPERATURE INDICATED) 5.7L "Y " SERIES (PORT)

Circuit Description:

The Manifold Air Temperature Sensor uses a thermistor to control the signal-voltage to the ECM. The ECM applies a voltage (about 5 volts) on CKT 472 to the sensor. When manifold air is cold, the sensor (Thermistor) resistance is high, therefore, the ECM will see a high signal voltage. As the air warms, the sensor resistance becomes less, and the voltage drops.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Code 25 will set if:
   - Signal voltage indicates a manifold air temperature greater than 150°C (302° F) for 12 seconds.
   - Time since engine start is 4 minutes or longer.
   - A vehicle speed is present.

Diagnostic Aids:

A "Scan" tool reads temperature of the air entering the engine and should read close to ambient air temperature, when engine is cold, and rise as underhood temperature increases.

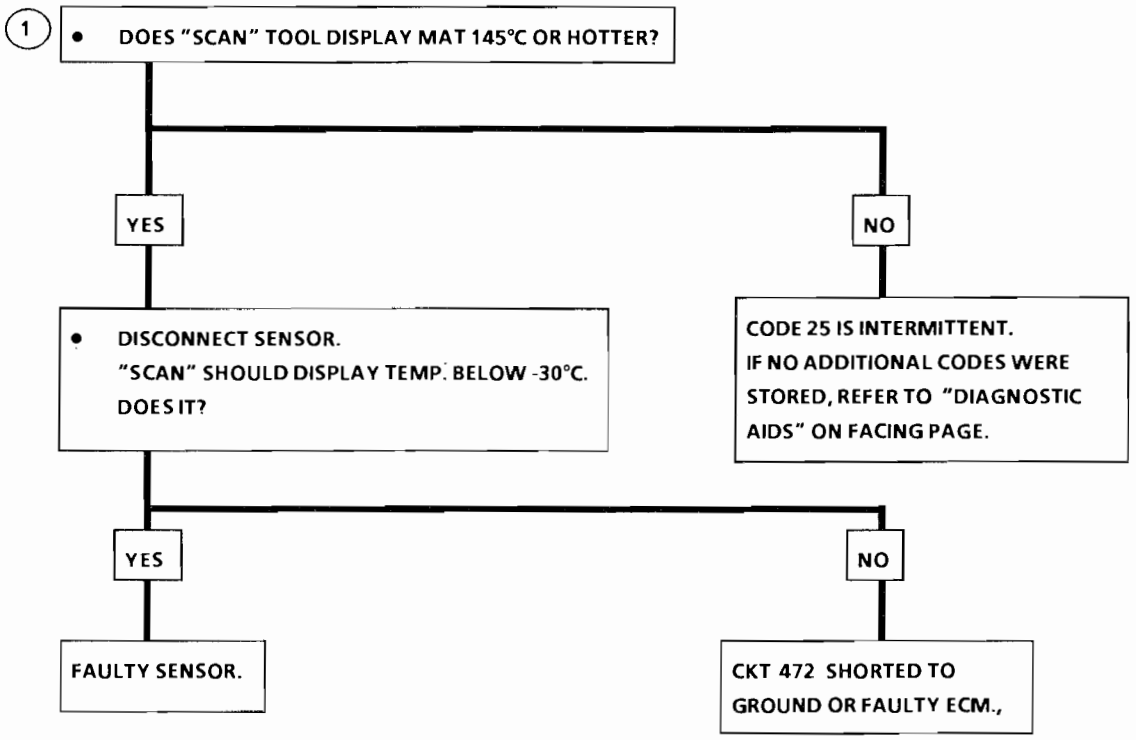
Check harness routing for possible short to ground in CKT 472.

Refer to "Intermittents" in Section "B".

"*SCAN*" DIAGNOSTICS

CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT (HIGH TEMPERATURE INDICATED) 5.7L "Y" SERIES (PORT)

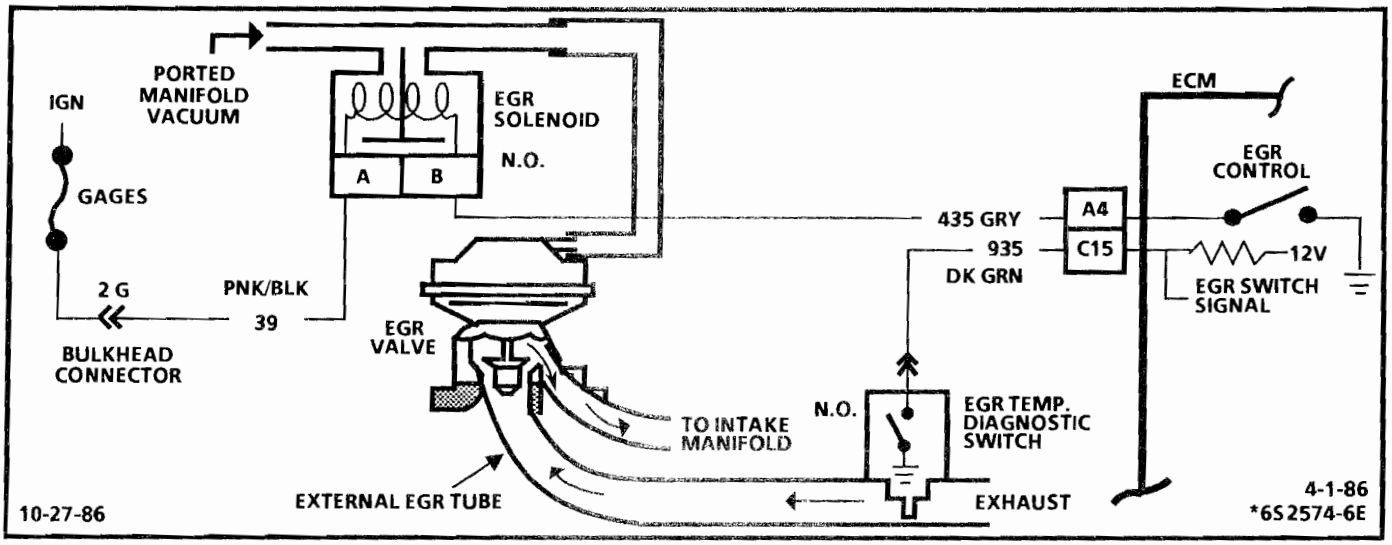


DIAGNOSTIC AID

MAT SENSOR TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)		
°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

9-10-86
• 7S 3190



CODE 32

EXHAUST GAS RECIRCULATION (EGR) CIRCUIT 5.7L "Y" SERIES (PORT)

Circuit Description:

The EGR valve vacuum is controlled by an ECM controlled solenoid. The ECM will turn the EGR "ON" and "OFF" (Duty Cycle) by grounding CKT 435. The duty cycle is calculated by the ECM based on information from the coolant and mass air flow sensor and engine rpms. There should be (NO EGR) when in Park or Neutral, TPS input below a specified value, or TPS indicating Wide Open Throttle (WOT).

With the ignition "ON", engine stopped, the EGR solenoid is de-energized and, by grounding the diagnostic terminal, the solenoid is energized.

Test Description: Step numbers refer to step numbers on diagnostic chart.

Code 32 means that the EGR diagnostic switch was closed during start-up or that the switch was not detected closed under the following conditions:

- Coolant temperature greater than 92°C (176°F).
- EGR duty cycle commanded by the ECM is greater than 75%.
- TPS less than ½ throttle, but not at idle.
- Codes 21,22,33,34 not present.
- All conditions above must be met for about 4 minutes.

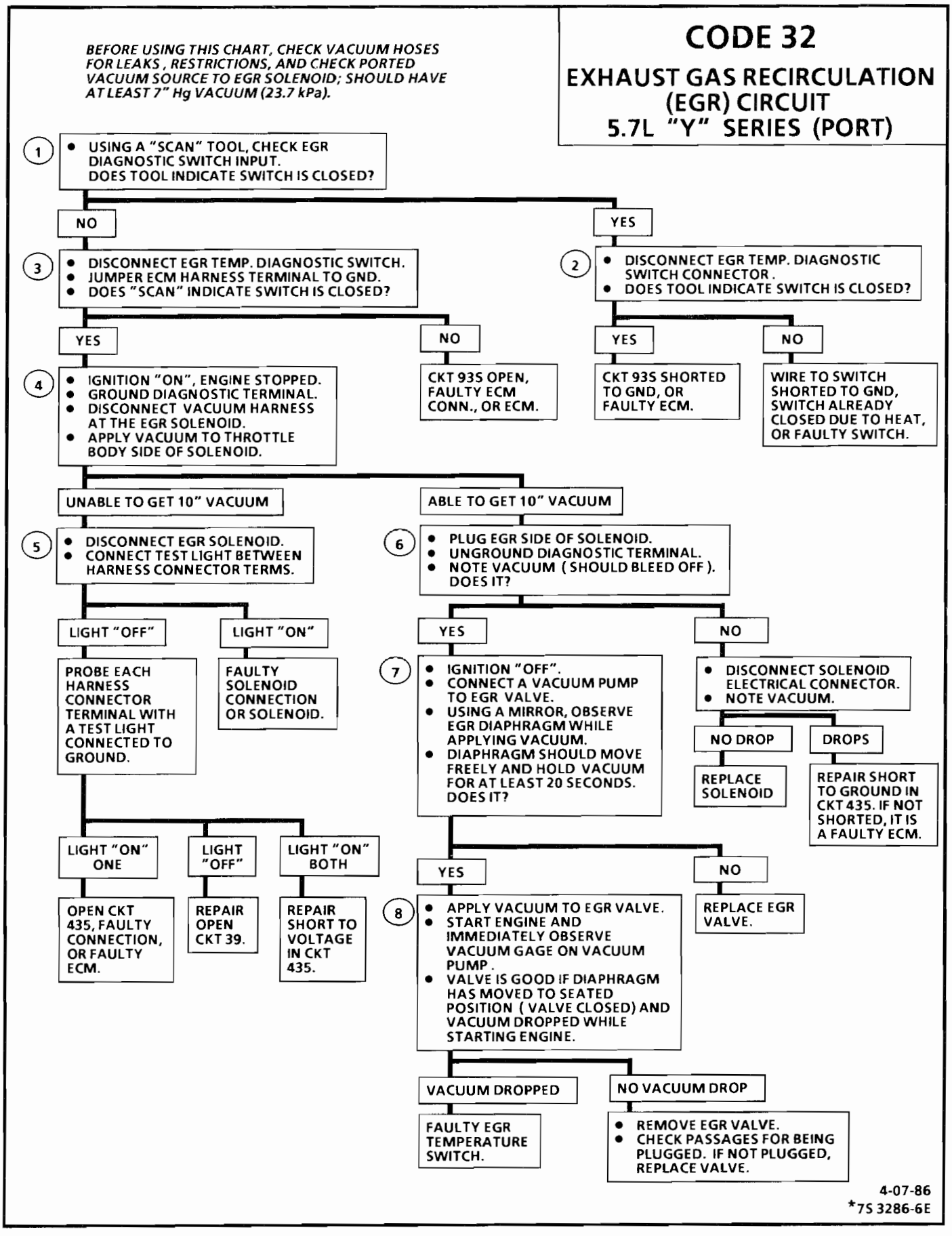
If the switch is detected closed during start-up, or if the switch is detected open when the above conditions are met, the "Service Engine Soon" light will remain "ON", unless the switch changes state.

1. This test will determine if the ECM set the code due to CKT 935 being grounded on start up. If the "Scan" does not indicate the switch is closed, but the customer complained of a "Service Engine Soon" light after start up, then this circuit should be checked carefully for an intermittent grounded condition.
2. If the "Scan" indicates the switch is no longer closed after disconnecting it, be sure the switch is not closed due to heat. (EGR being "ON" prior to test).
3. This test will check for a possible open in CKT 935. The ECM supplies 9-12 volts to CKT 935 and the "Scan" should indicate switch being closed when CKT 935 is grounded.
4. By grounding the diagnostic terminal, the EGR solenoid should close, and allow vacuum to be applied and the vacuum should hold.
5. This test will determine if the electrical control part of the system is at fault, or if the connector or solenoid are at fault.
6. By plugging the EGR valve side and ungrounding the diagnostic terminal, the solenoid valve should open and allow vacuum to bleed off through the vent.
7. With the engine not running and vacuum is applied to the valve, the valve should move to the fully open position.
8. Due to this engine using a negative back pressure valve, the valve should close when the engine is cranked over.

CODE 32

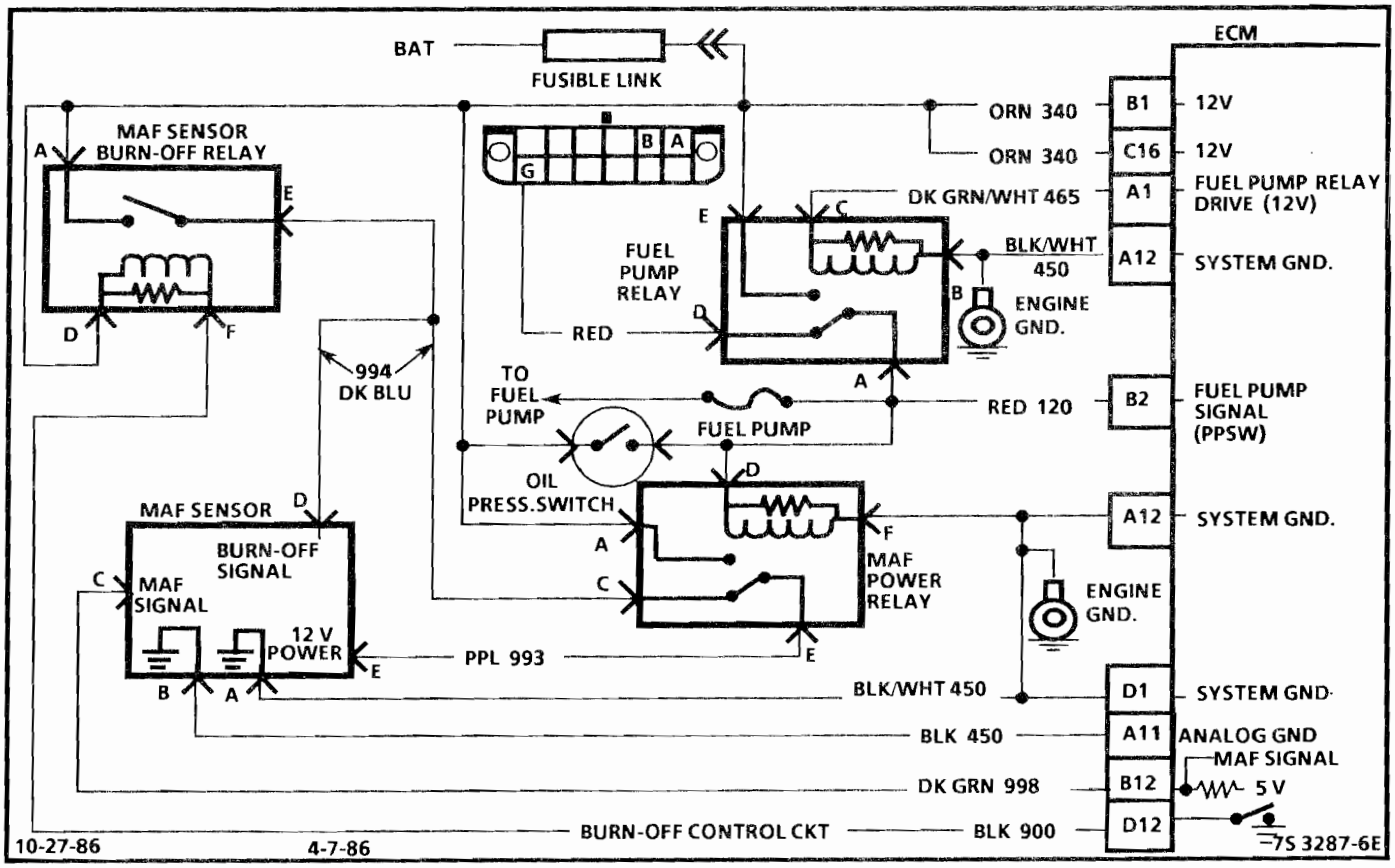
EXHAUST GAS RECIRCULATION (EGR) CIRCUIT 5.7L "Y" SERIES (PORT)

BEFORE USING THIS CHART, CHECK VACUUM HOSES FOR LEAKS, RESTRICTIONS, AND CHECK PORTED VACUUM SOURCE TO EGR SOLENOID; SHOULD HAVE AT LEAST 7" Hg VACUUM (23.7 kPa).



4-07-86

*7S 3286-6E



CODE 33

MASS AIR FLOW (MAF) SENSOR CIRCUIT (GM/SEC HIGH) 5.7L "Y" SERIES

Circuit Description:

The Mass Air Flow (MAF) sensor measures the amount of air which passes through it. The ECM uses this information to determine the operating condition of the engine, to control fuel delivery. For a detailed description of the MAF sensor operation refer to Section C.

The oil pressure switch or the ECM, through control of the fuel pump relay, will provide 12 volts for the MAF power relay which provides the 12 volts needed by the MAF sensor.

The ECM provides a current limiting 5V on the signal line (CKT 998). The MAF sensor then changes the signal by dropping the voltage so that with low air flow the ECM sees a low voltage and a high air flow will cause the ECM to see near the 5 volt supply.

Test Description: Step numbers refer to step numbers on diagnostic chart.

CODE 33 indicates: ECM has seen flow in excess of 45 grams per second (above about 2.2 volts) for one second when:

- Engine is first started.
  OR
- TPS is less than $\frac{1}{4}$ throttle.
- RPM is less than 2000.

Due to the 5 volt pull-up resistor in the ECM, if CKT 998 becomes open, the ECM will see a high voltage signal and set a CODE 33.

1. This test will determine if the conditions to set the code still exist.
2. With the ALDL terminal "G" jumpered to 12 volts, there should be 12 volts at the sensor. If no voltage is present, make sure that the fuel pump is running. If not, repair fuel pump circuit.
3. If a burn off signal is present at the MAF sensor with the engine running, a Code 33 will set. Be sure no voltage is present on CKT 994 during the first 25 seconds that the fuel pump runs or after the 2 second period.
4. The ECM sources a voltage (4-6 volts) to the MAF sensor on CKT 998. This test checks for that voltage.

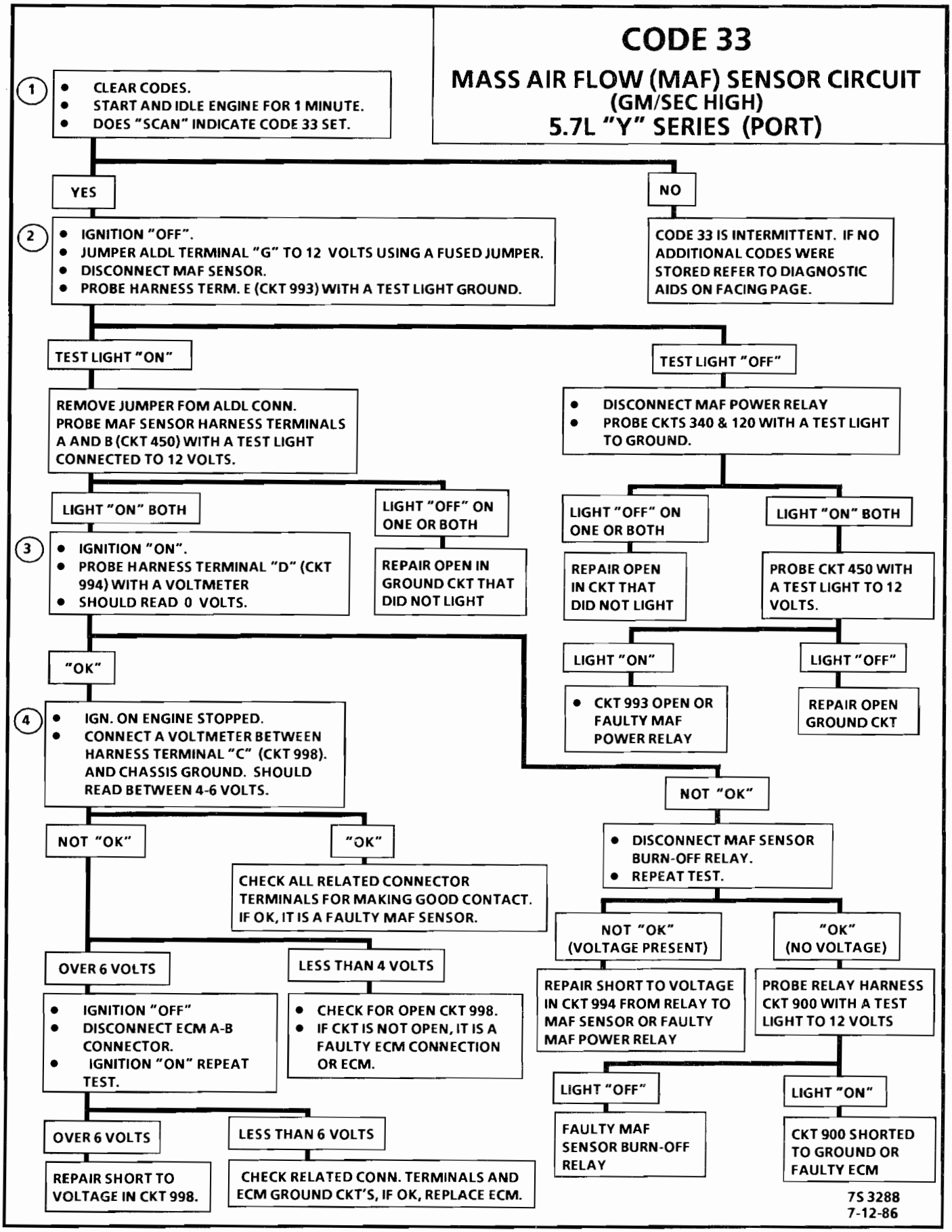
Diagnostic Aids:

Intermittent: By jumpering the fuel pump test terminal (G term. of ALDL) to 12 volts, the MAF sensor will stay powered up and the signal line should see a low voltage, less than 250MV or low grams per second on a "SCAN" tool. By wiggling the related wiring the intermittent may be detected. Also, an erratic signal with the engine running may indicate faulty wiring or components. A burn-off signal to the MAF sensor, while running, may result in a Code 33. Be sure relay connections are clean and check CKT 994 for a potential short to voltage.

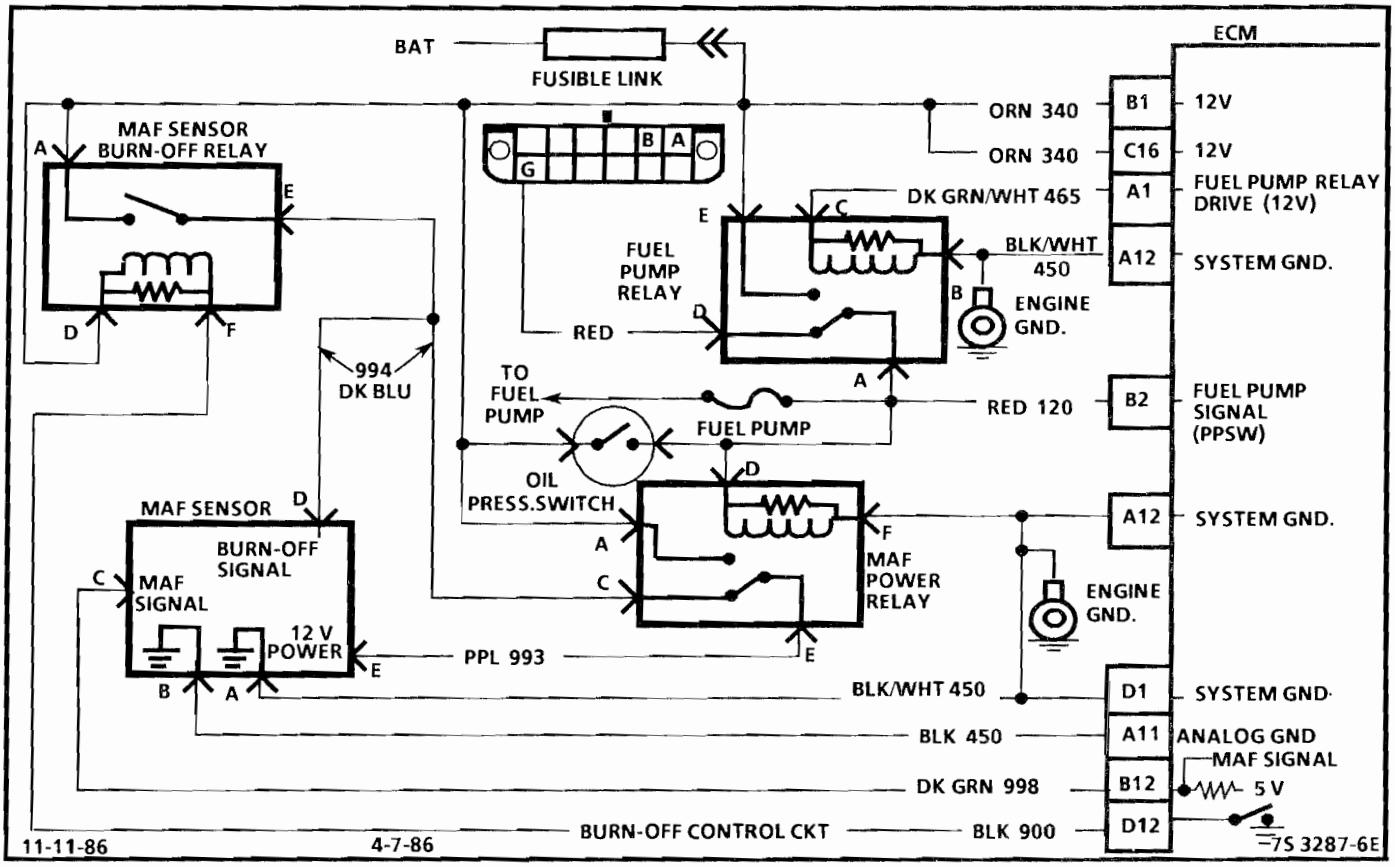
CODE 33

MASS AIR FLOW (MAF) SENSOR CIRCUIT (GM/SEC HIGH)

5.7L "Y" SERIES (PORT)



7S 3288
7-12-86



CODE 34

MASS AIR FLOW (MAF) SENSOR (GM/SEC LOW) 5.7L "Y" SERIES (PORT)

Circuit Description:

The Mass Air Flow (MAF) sensor measures the amount of air which passes through it. The ECM uses this information to determine the operating condition of the engine, to control fuel delivery. For a detailed description of the MAF sensor operation refer to Section "C".

The oil pressure switch or the ECM, through control of the fuel pump relay, will provide 12 volts for the MAF power relay which provides the 12 volts needed by the MAF sensor.

The ECM provides a current limiting 5V on the signal line (CKT 998). The MAF sensor then changes the signal by dropping the voltage so that with low air flow the ECM sees a low voltage and a high air flow will cause the ECM to see near the 5 volt supply.

Test Description: Step numbers refer to step numbers on diagnostic chart.

CODE 34 indicates: ECM has seen low air flow less than 2.5 gm/sec. (low voltage) for one second when:

- Engine is first started
  OR
- RPM above 600
- TPS above 6%. To obtain 6%, the engine has to be running at about 2300 rpm in neutral.

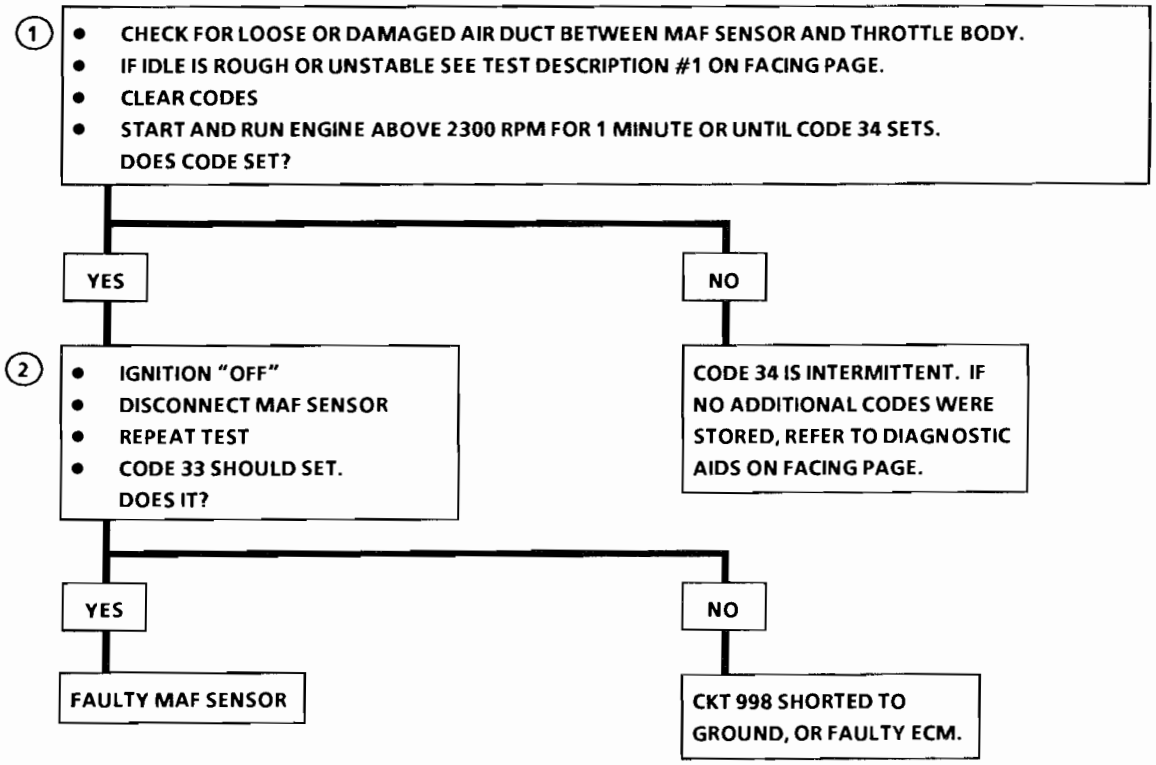
1. A Code 34 may be caused by an engine that exhibits a low, rough, unstable or incorrect idle problem. If this condition exists, disconnect the MAF sensor. If the unstable idle still exists, see Symptoms in Section "B". (Rough, unstable, incorrect idle, or stalling.) If the idle improved with the sensor disconnected, replace it. Code 34 could also result from a dirty or misadjusted throttle body. Refer to Section "C2" for minimum idle speed adjustment.
2. This test will determine if the conditions still exist to set a code or if the problem is intermittent. With the MAF sensor disconnected, the ECM should see a high signal voltage and set a Code 33. If a Code 34 resets, then the wiring or the ECM is at fault.

Diagnostic Aids:

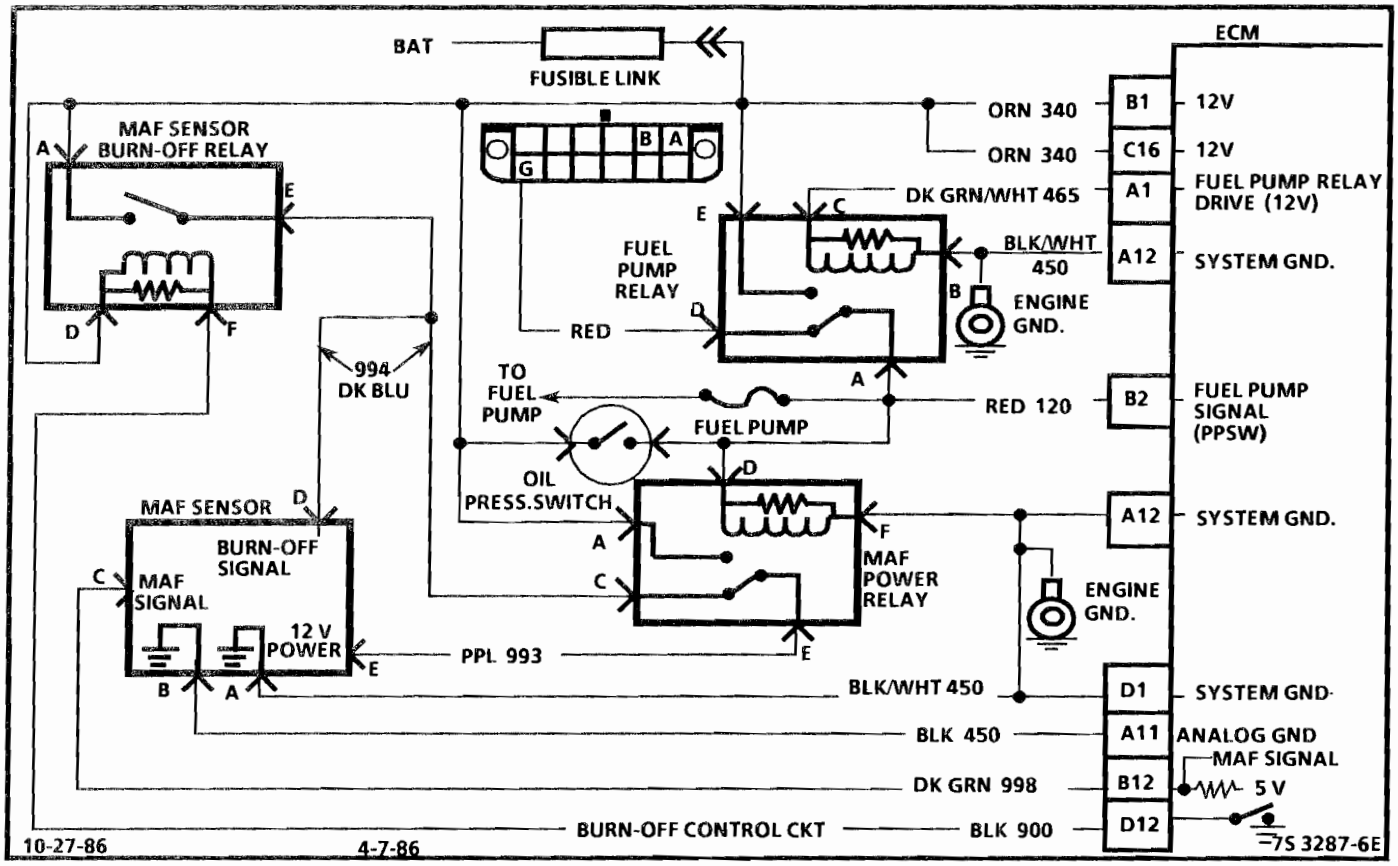
A low, rough, or unstable idle could result in a Code 34. Also, be sure air ducts are tight and not cracked. Check CKT 998 for a potential short to ground. Refer to "Intermittents" in Section "B". Code 34 could also result from a dirty or misadjusted throttle body. Refer to Section "C2" for minimum idle speed adjustment.

CODE 34

MASS AIR FLOW (MAF) SENSOR
(GM/SEC LOW)
5.7L "Y" SERIES (PORT)



*7S3289-6E
4-16-86



CODE 36

MAF BURN-OFF CIRCUIT
5.7L "Y" SERIES (PORT)

Circuit Description:

The Mass Air Flow (MAF) sensor measures the amount of air which passes through it. The ECM uses this information to determine the operating condition of the engine, to control fuel delivery. For a detailed description of the MAF sensor operation see Section C.

Due to contaminates in the atmosphere, a residue may build up on the MAF Sensor sensing wire. To maintain an accurate reading from the sensor, a "burn-off" cycle will occur, when the ignition is turned "OFF", after the engine had been running a specified amount of time and engine warmed up. The burn-off function is enabled when the ECM grounds CKT 900, which energizes the MAF Sensor burn-off relay. With the MAF Sensor burn-off relay energized, voltage will be supplied to the MAF Sensor terminal "D". Voltage will also be supplied through the normally closed set of contacts in the MAF Power relay, which will supply 12 volts to terminal "E" of the MAF Sensor.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. This test will determine if the burn-off function is operative or if the code was set due to an intermittent condition.
2. Check for continuous 12 volt supply to burn-off relay.
3. Grounding CKT 900 should energize the relay and close the contacts.
4. With the burn-off relay energized there should be 12 volts supplied to the MAF Sensor on terminal "D" & "E" (CKTs 993 and 994).

Diagnostic Aids:

The Code 36 could have been set due to a poor connection at any of the relays or the MAF sensor. Be sure that these connections and terminals are OK. A faulty MAF sensor should not be considered as the cause if Code 36 is set.

Refer to "Intermittents" in Section "B".

"SCAN" DIAGNOSTICS

CODE 36

MAF BURN-OFF CIRCUIT 5.7L "Y" SERIES (PORT)

1
- IGNITION "OFF", CLEAR CODES.
- START ENGINE AND RUN UNTIL SYSTEM GOES CLOSED LOOP.
- TURN IGNITION "OFF" AND WAIT 20 SECONDS.
- START AND IDLE ENGINE FOR 30 SECONDS OR UNTIL S.E.S. LIGHT COMES ON.

IS CODE 36 SET?

YES

2
- DISCONNECT MAF SENSOR BURN-OFF RELAY.
- PROBE BOTH 340 CKTS WITH A TEST LIGHT TO GROUND.

LIGHT "ON" BOTH

3
- RECONNECT RELAY.
- DISCONNECT MAF SENSOR.
- GROUND BURN-OFF RELAY CKT 900.
- PROBE MAF SENSOR HARNESS TERMINAL "D" WITH A TEST LIGHT TO GROUND.

LIGHT "ON"

4
- CKT 900 STILL GROUNDED.
- PROBE TERMINAL "E" (CKT 993) WITH A TEST LIGHT TO GROUND.

LIGHT "ON"
- DISCONNECT BURN-OFF RELAY.
- IGNITION "ON".
- PROBE CKT 900 WITH A TEST LIGHT TO GROUND.

LIGHT "ON"

REPAIR SHORT TO VOLTAGE IN CKT 900

LIGHT "OFF"

FAULTY ECM CONNECTION OR ECM. CODE 36 CAN SET DUE TO A POOR CONNECTION AT ANY OF THE RELAYS OR THE MAF SENSOR, OR COULD BE CAUSED BY HIGH RESISTANCE IN THE RELAY CONTACTS OR CONNECTIONS. BE SURE THAT THESE CONNECTIONS AND TERMINALS ARE OK BEFORE REPLACING ECM.

LIGHT "OFF"
- OPEN CKT 993, OPEN CIRCUIT BETWEEN MAF SENSOR RELAY AND THE BURN-OFF RELAY, FAULTY CONNECTION, OR FAULTY MAF SENSOR POWER RELAY.

LIGHT "OFF"

CKT 900 OPEN, CKT 994 OPEN OR SHORTED TO GROUND, OR FAULTY CONNECTION OR FAULTY RELAY.

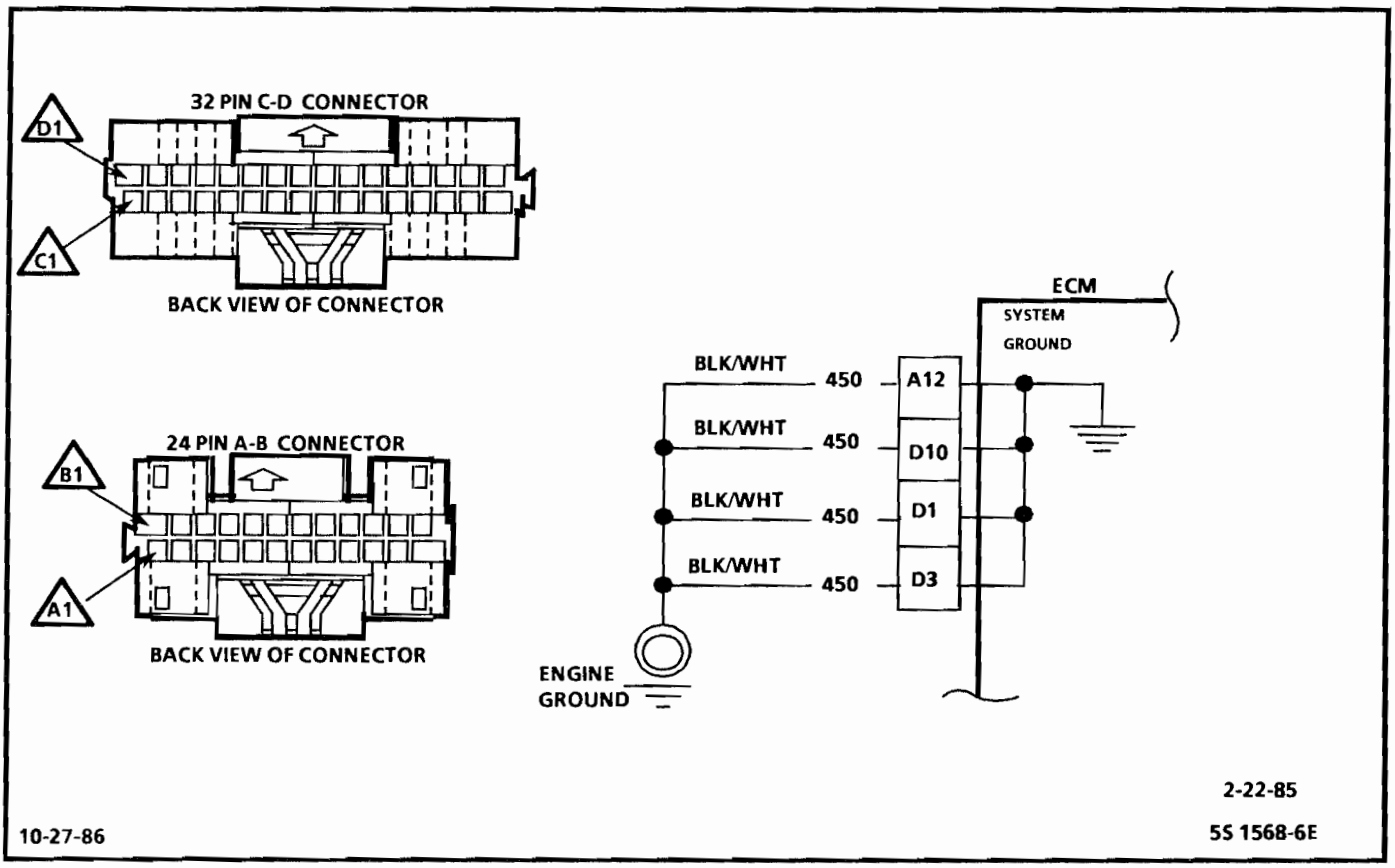
LIGHT "OFF"

REPAIR OPEN IN CKT THAT DID NOT LIGHT.

NO

CODE 36 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

11-10-86
* 7S 3290-6E



CODE 41

CYLINDER SELECT ERROR
(FAULTY OR INCORRECT MEM-CAL)
5.7L "Y" SERIES (PORT)

Test Description: Step numbers refer to step numbers on diagnostic chart.

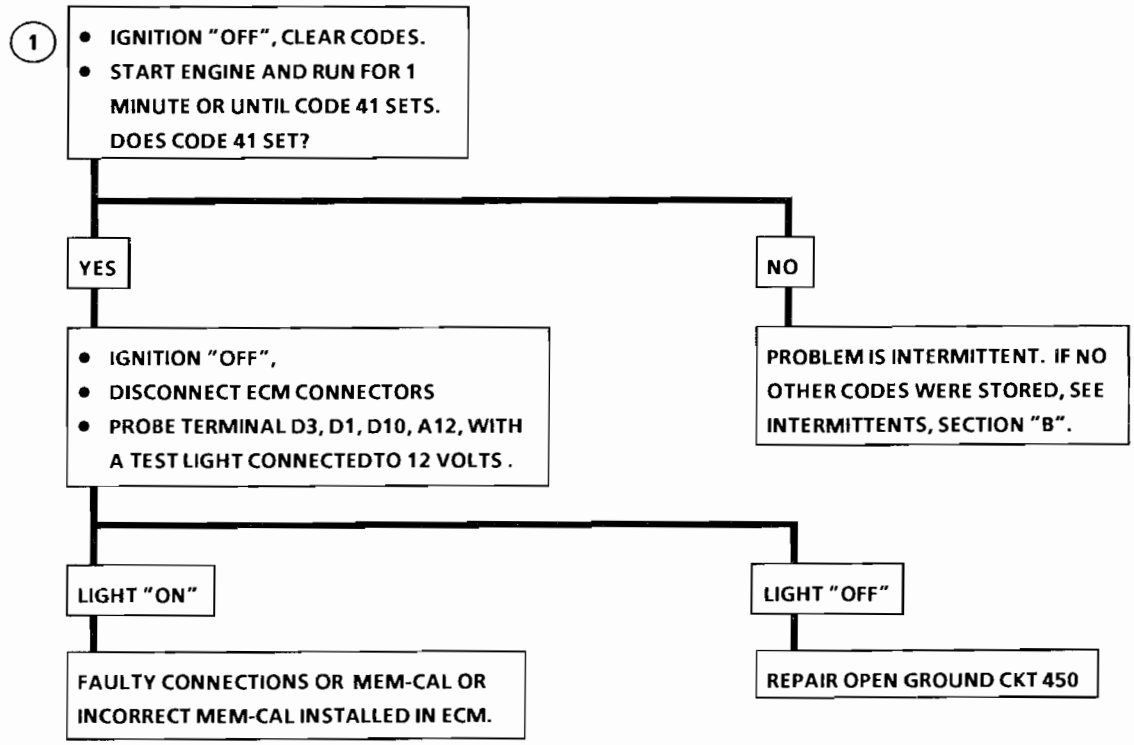
1. The ECM used for this engine can also be used for other engines, and the difference is in the Mem-Cal. If a Code 41 sets, the incorrect Mem-Cal has been installed or it is faulty and it must be replaced.

Diagnostic Aids:

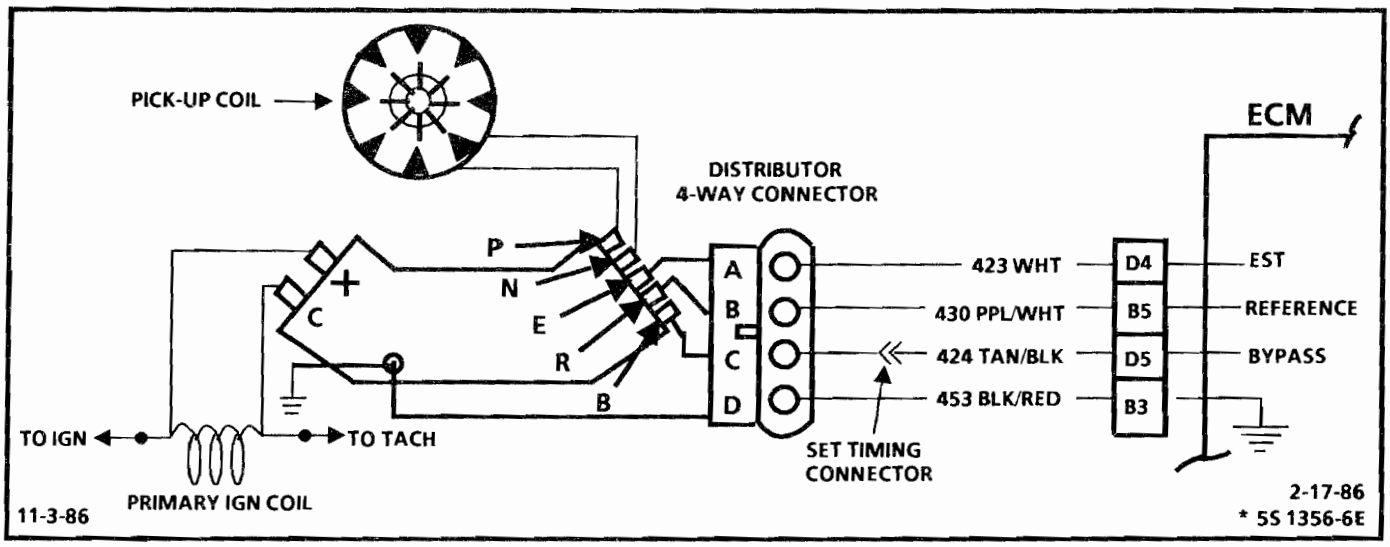
Check Mem-Cal to be sure locking tabs are secure.

CODE 41

CYLINDER SELECT ERROR (FAULTY OR INCORRECT MEM-CAL) 5.7L "Y" SERIES (PORT)



* 5S 1569-6E
6-09-86



CODE 42

ELECTRONIC SPARK TIMING (EST) CIRCUIT 5.7L "Y" SERIES (PORT)

Circuit Description:

When the system is running on the Ignition Module, that is, no voltage on the bypass line, the Ignition Module grounds the EST signal. The ECM expects to see no voltage on the EST Line during this condition. If it sees a voltage, it sets Code 42 and will not go into the EST mode.

When the rpm for EST is reached (about 400 rpm), and bypass voltage applied, the EST should no longer be grounded in the Ignition Module so the EST voltage should be varying.

If the bypass line is open or grounded, the Ignition Module will not switch to EST mode, so the EST voltage will be low and Code 42 will be set.

If the EST line is grounded, the Ignition Module will switch to EST, but because the line is grounded there will be no EST signal. A Code 42 will be set.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Code 42 means the ECM has seen an open or short to ground in the EST or bypass circuits. This test confirms Code 42 and that the fault causing the code is present.
2. Checks for a normal EST ground path through the ignition module. An EST CKT 423 shorted to ground will also read less than 500 ohms; however, this will be checked later.
3. As the test light voltage touches CKT 424, the module should switch causing the ohmmeter to "overrange" if the meter is in the 1000-2000 ohms position. Selecting the 10-20,000 ohms position will indicate above 5000 ohms. The important thing is that the module "switched".
4. The module did not switch and this step checks for:
   - EST CKT 423 shorted to ground.
   - Bypass CKT 424 open.
   - Faulty ignition module connection or module.
5. Confirms that Code 42 is a faulty ECM and not an intermittent in CKTs 423 or 424.

Diagnostic Aids:

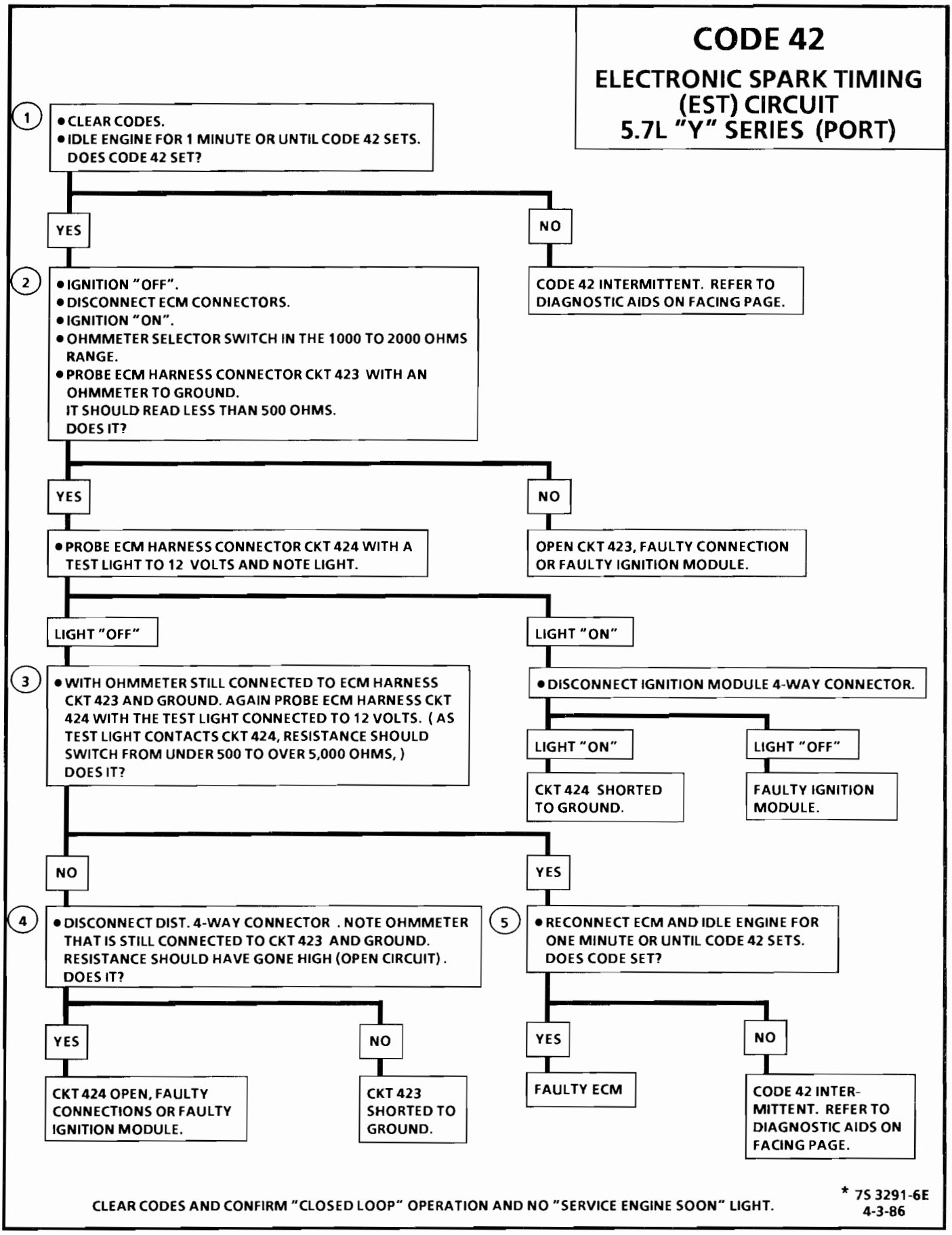
The "Scan" tool does not have any ability to help diagnose a Code 42 problem.

A Mem-Cal not fully seated in the ECM can result in a Code 42.

Refer to "Intermittents" in Section "B".

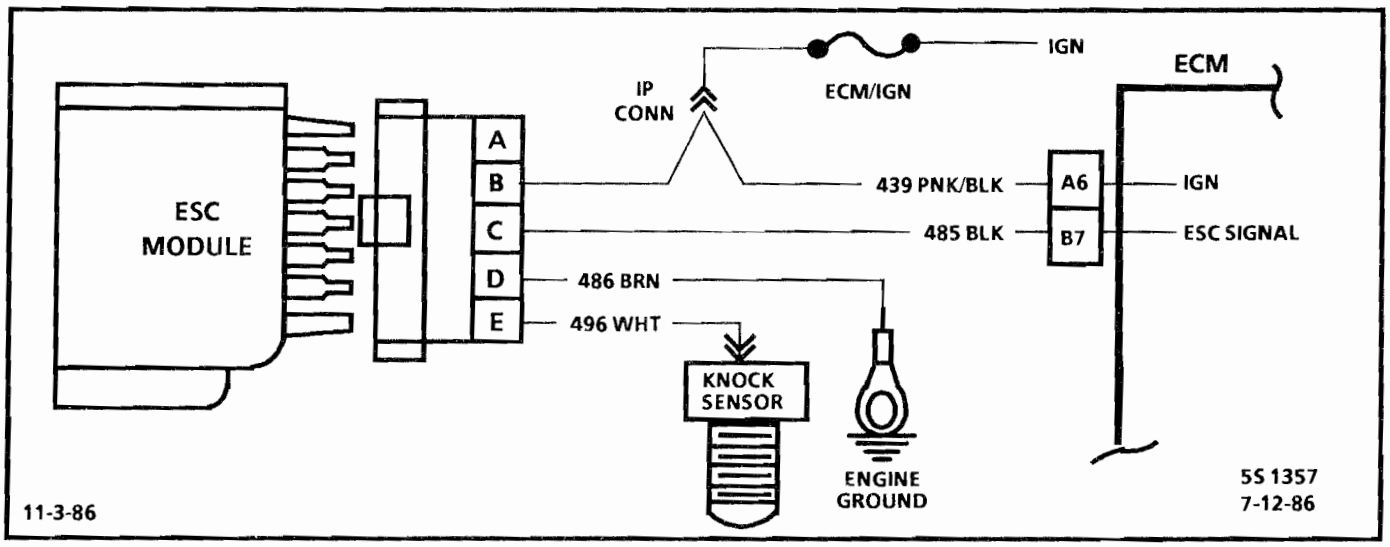
CODE 42

ELECTRONIC SPARK TIMING (EST) CIRCUIT 5.7L "Y" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

* 7S 3291-6E
4-3-86



CODE 43

ELECTRONIC SPARK CONTROL (ESC) CIRCUIT 5.7L "Y" SERIES (PORT)

Circuit Description:

Electronic spark control is accomplished with a module that sends a voltage signal to the ECM. As the knock sensor detects engine knock, the voltage from the ESC module to the ECM drops, and this signals the ECM to retard timing. The ECM will retard the timing, when knock is detected and rpm is above about 900 rpm.

Code 43 means the ECM has been low voltage at CKT 485 terminal "B7" for longer than 5 seconds with the engine running or the system has failed the functional check.

This system performs a functional check once per start up to check the ESC system. To perform this test, the ECM will advance the spark when coolant is above 95°C and at a high load condition (near WOT). The ECM then checks the signal at "B7" to see if a knock is detected. The functional check is performed once per start up and, if knock is detected when coolant is below 95°C (194°F), the test has passed and the functional check will not be run. If the functional check fails, the "Service Engine Soon" light will remain "ON" until ignition is turned "OFF", or until a knock signal is detected.

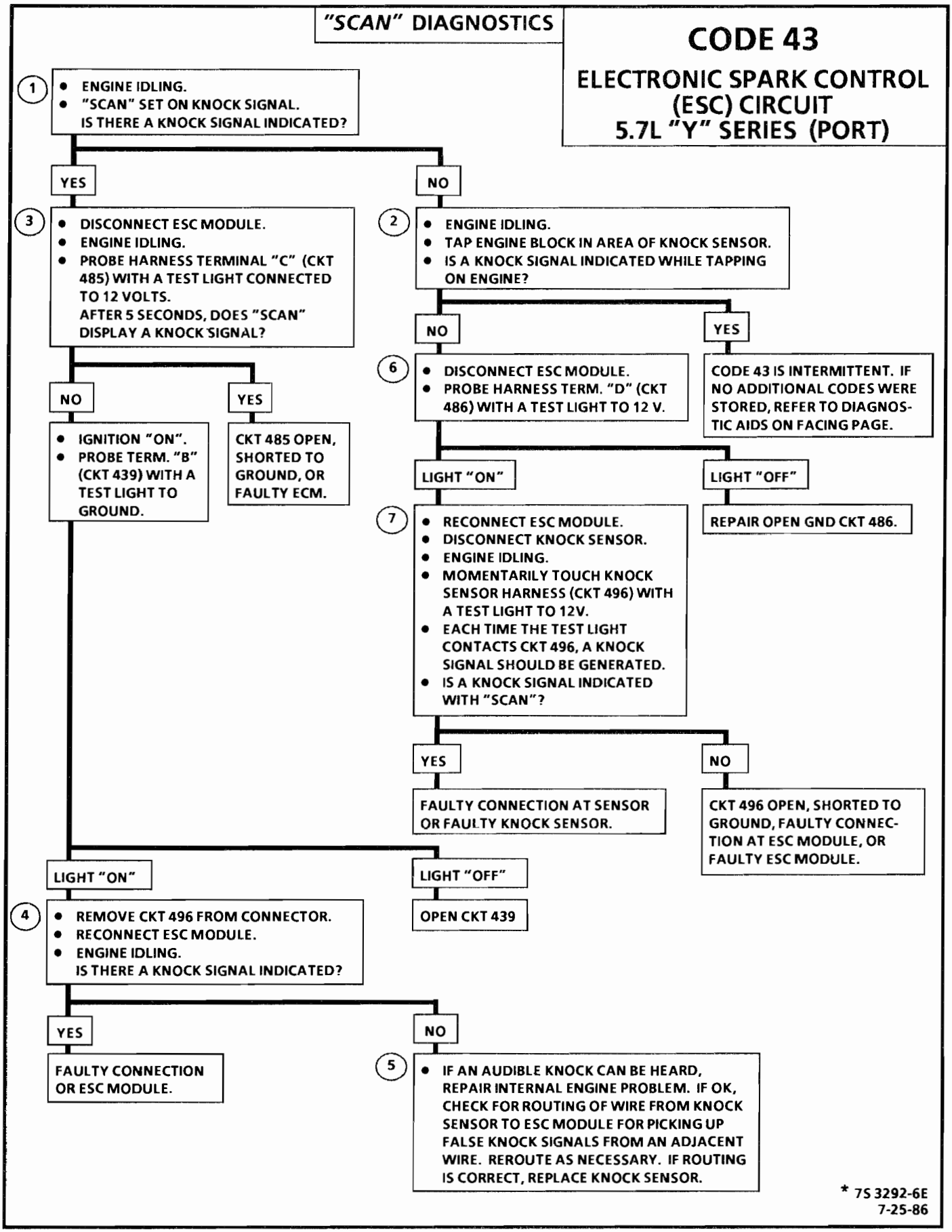
Test Description: Test numbers refer to step numbers on diagnostic chart.

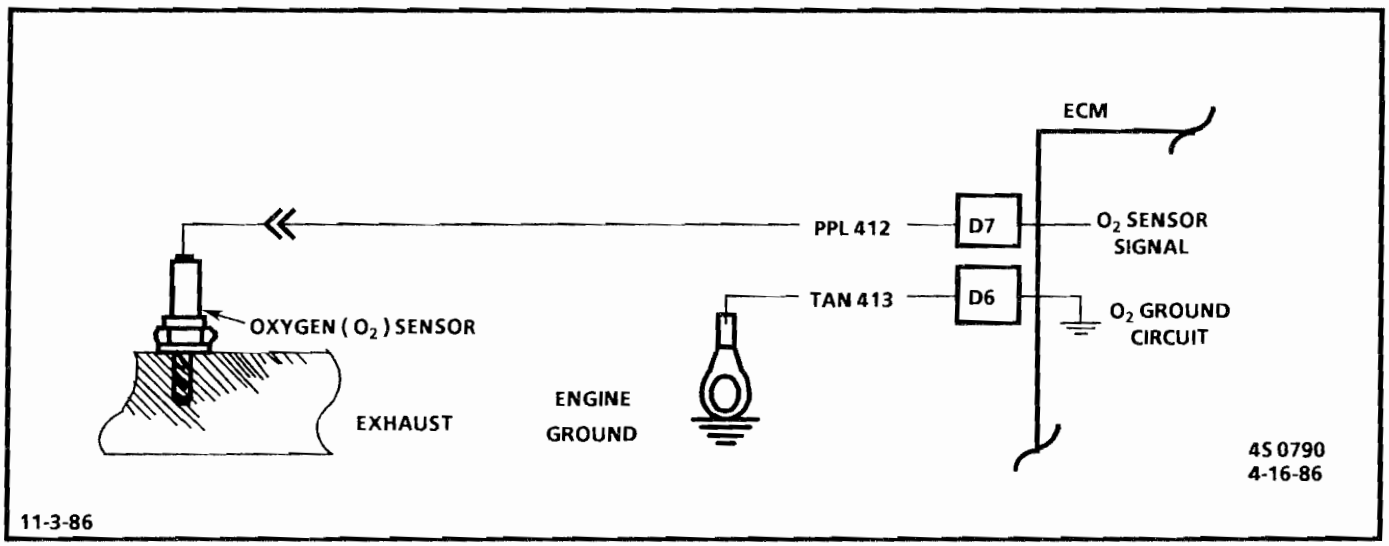
1. If the conditions for a Code 43 are present, the "Scan" will always display "yes". There should not be a knock at idle unless an internal engine problem, or a system problem, exists.
2. This test will determine if the system is functioning at this time. Usually, a knock signal can be generated by tapping on the right exhaust manifold. If no knock signal is generated, try tapping on block close to the area of the sensor.
3. Because Code 43 sets when the signal voltage on CKT 485 remains low, this test should cause the signal on CKT 485 to go high. The 12 volts signal should be seen by the ECM as "no knock", if the ECM and wiring are OK.
4. This test will determine if the knock signal is being detected on CKT 496, or if the ESC module is at fault.
5. If CKT 496 is routed to close to secondary ignition wires, the ESC module may see the interference as a knock signal.
6. This checks the ground circuit to the module. An open ground will cause the voltage on CKT 485 to be about 12 volts, which would cause the Code 43 functional test to fail.
7. Contacting CKT 496 with a test light to 12 volts should generate a knock signal. This will determine if the ESC module is operating correctly.

Diagnostic Aids:

Code 43 can be caused by a faulty connection at the knock sensor at the ESC module or at the ECM. Also, check CKT 485 for possible open or short to ground.

Refer to Intermittents in Section "B".


"SCAN" DIAGNOSTICS
CODE 43
ELECTRONIC SPARK CONTROL (ESC) CIRCUIT 5.7L "Y" SERIES (PORT)
1
• ENGINE IDLING.
• "SCAN" SET ON KNOCK SIGNAL. IS THERE A KNOCK SIGNAL INDICATED?
YES
NO
3
• DISCONNECT ESC MODULE.
• ENGINE IDLING.
• PROBE HARNESS TERMINAL "C" (CKT 485) WITH A TEST LIGHT CONNECTED TO 12 VOLTS. AFTER 5 SECONDS, DOES "SCAN" DISPLAY A KNOCK SIGNAL?
NO
YES
• IGNITION "ON".
• PROBE TERM. "B" (CKT 439) WITH A TEST LIGHT TO GROUND.
CKT 485 OPEN, SHORTED TO GROUND, OR FAULTY ECM.
2
• ENGINE IDLING.
• TAP ENGINE BLOCK IN AREA OF KNOCK SENSOR.
• IS A KNOCK SIGNAL INDICATED WHILE TAPPING ON ENGINE?
NO
YES
CODE 43 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.
6
• DISCONNECT ESC MODULE.
• PROBE HARNESS TERM. "D" (CKT 486) WITH A TEST LIGHT TO 12 V.
LIGHT "ON"
LIGHT "OFF"
REPAIR OPEN GND CKT 486.
7
• RECONNECT ESC MODULE.
• DISCONNECT KNOCK SENSOR.
• ENGINE IDLING.
• MOMENTARILY TOUCH KNOCK SENSOR HARNESS (CKT 496) WITH A TEST LIGHT TO 12V.
• EACH TIME THE TEST LIGHT CONTACTS CKT 496, A KNOCK SIGNAL SHOULD BE GENERATED.
• IS A KNOCK SIGNAL INDICATED WITH "SCAN"?
YES
NO
FAULTY CONNECTION AT SENSOR OR FAULTY KNOCK SENSOR.
CKT 496 OPEN, SHORTED TO GROUND, FAULTY CONNECTION AT ESC MODULE, OR FAULTY ESC MODULE.
LIGHT "ON"
LIGHT "OFF"
OPEN CKT 439
4
• REMOVE CKT 496 FROM CONNECTOR.
• RECONNECT ESC MODULE.
• ENGINE IDLING. IS THERE A KNOCK SIGNAL INDICATED?
YES
NO
FAULTY CONNECTION OR ESC MODULE.
5
• IF AN AUDIBLE KNOCK CAN BE HEARD, REPAIR INTERNAL ENGINE PROBLEM. IF OK, CHECK FOR ROUTING OF WIRE FROM KNOCK SENSOR TO ESC MODULE FOR PICKING UP FALSE KNOCK SIGNALS FROM AN ADJACENT WIRE. REROUTE AS NECESSARY. IF ROUTING IS CORRECT, REPLACE KNOCK SENSOR.
* 7S 3292-6E
7-25-86



CODE 44

OXYGEN SENSOR CIRCUIT
(LEAN EXHAUST INDICATION)
5.7L "Y" SERIES (PORT)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D6" and "D7". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt, if the exhaust is rich, down through about .10 volt, if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below about 360°C (600°F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Code 44 is set when the O_2 sensor signal voltage on CKT 412;
   - Remains below .2 volt for 50 seconds.
   - And the system is operating in "Closed Loop".

Diagnostic Aids:

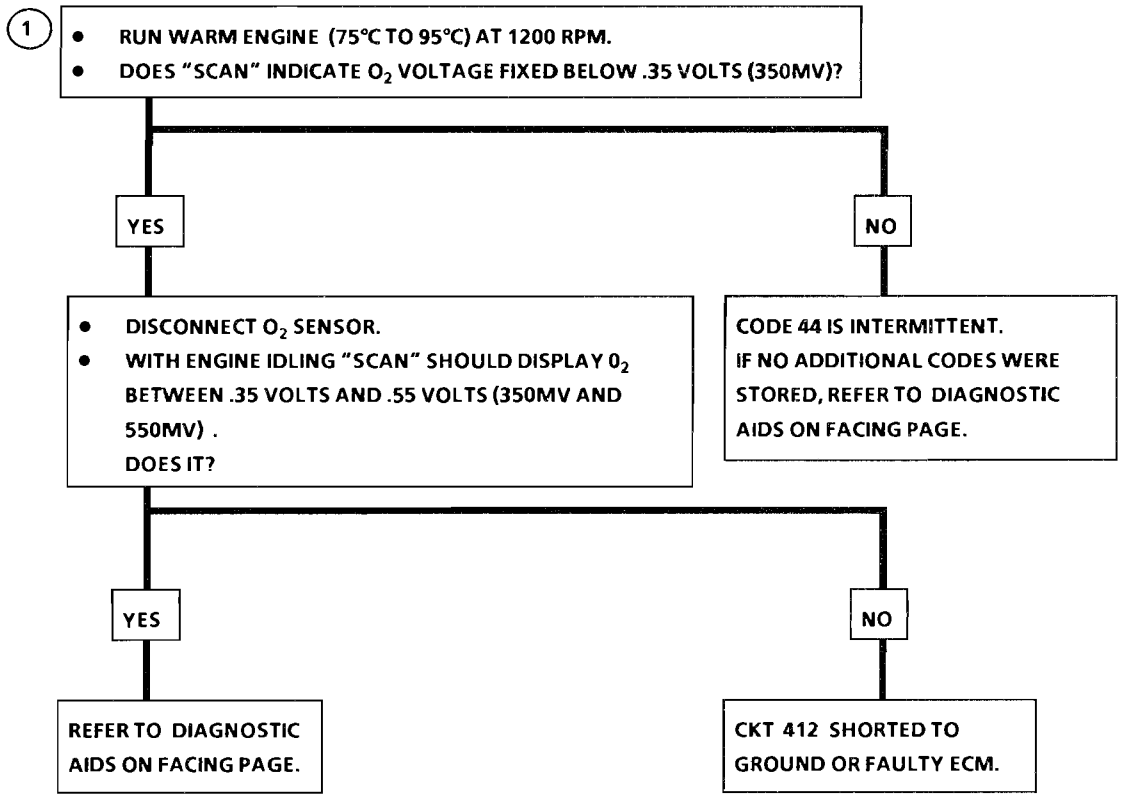
Using the "Scan", observe the block learn values at different rpm and air flow conditions. The "Scan", also, displays the block cells, so the block learn values can be checked in each of the cells to determine when the Code 44 may have been set. If the conditions for Code 44 exist, the block learn values will be around 150.

- O_2 Sensor Wire: Sensor pigtail may be mispositioned and contacting the exhaust manifold.
- Check for intermittent ground in wire between connector and sensor.
- MAF Sensor: A Mass Air Flow (MAF) sensor output that causes the ECM to sense a lower than normal air flow will cause the system to go lean. Disconnect the MAF sensor and, if the lean condition is gone, replace the MAF sensor.
- Lean Injector(s): Perform injector balance test Chart C-2A.
- Fuel Contamination: Water, even in small amounts, near the in-tank fuel pump inlet can be delivered to the injectors. The water causes a lean exhaust and can set a Code 44.
- Fuel Pressure: System will be lean if pressure is too low. It may be necessary to monitor fuel pressure while driving the car at various road speeds and/or loads to confirm. See Fuel System diagnosis CHART A-7.
- Exhaust Leaks: If there is an exhaust leak, the engine can cause outside air to be pulled into the exhaust and past the sensor. Vacuum or crankcase leaks can cause a lean condition.
- AIR System: Be sure air is not being directed to the exhaust ports while in "Closed Loop". If the block learn value goes down, while squeezing air hose to left side exhaust ports, refer to Chart C-6.
- If the above are OK, it is a faulty oxygen sensor.

"SCAN" DIAGNOSTICS

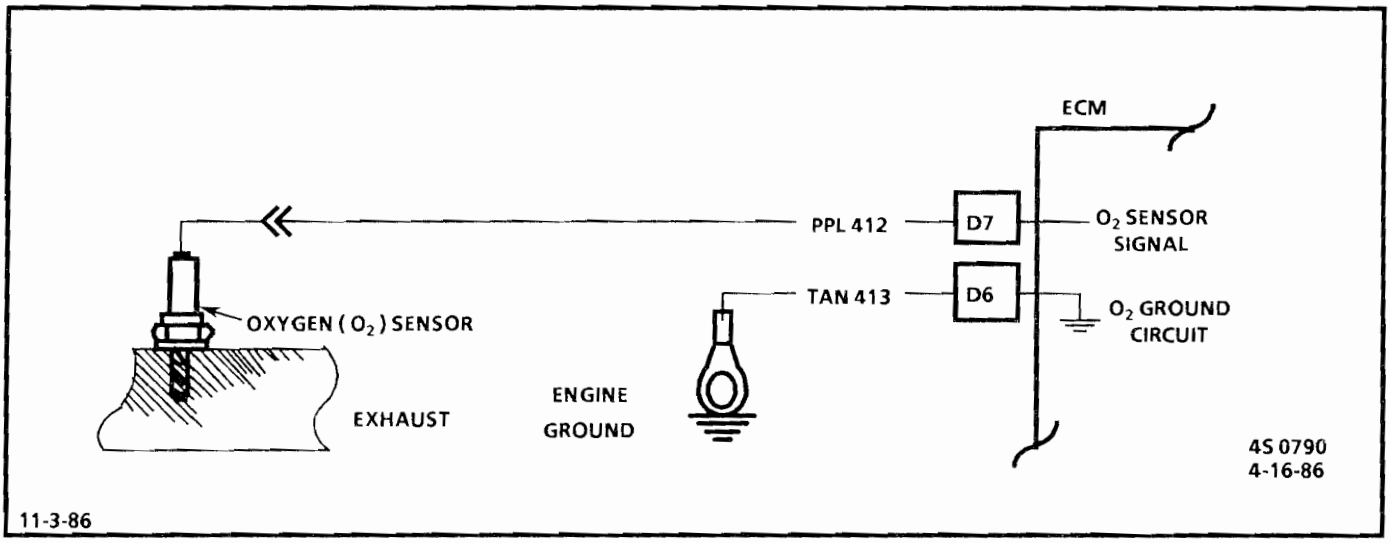
CODE 44

OXYGEN SENSOR CIRCUIT (LEAN EXHAUST INDICATED) 5.7L "Y" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

10-20-86
*7S 3191



CODE 45

OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
5.7L "Y" SERIES (PORT)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D6" and "D7". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt, if the exhaust is rich, down through about .10 volt, if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below about 360°C (600°F). An open sensor circuit, or cold sensor, causes "Open Loop" operation.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Code 45 is set when the O_2 sensor signal voltage or CKT 412;
   - Remains above .7 volt for 50 seconds; and in "Closed Loop".
   - Engine time after start is 1 minute or more.
   - Throttle angle greater than 2% (about .2 volts above idle voltage).

Diagnostic Aids:

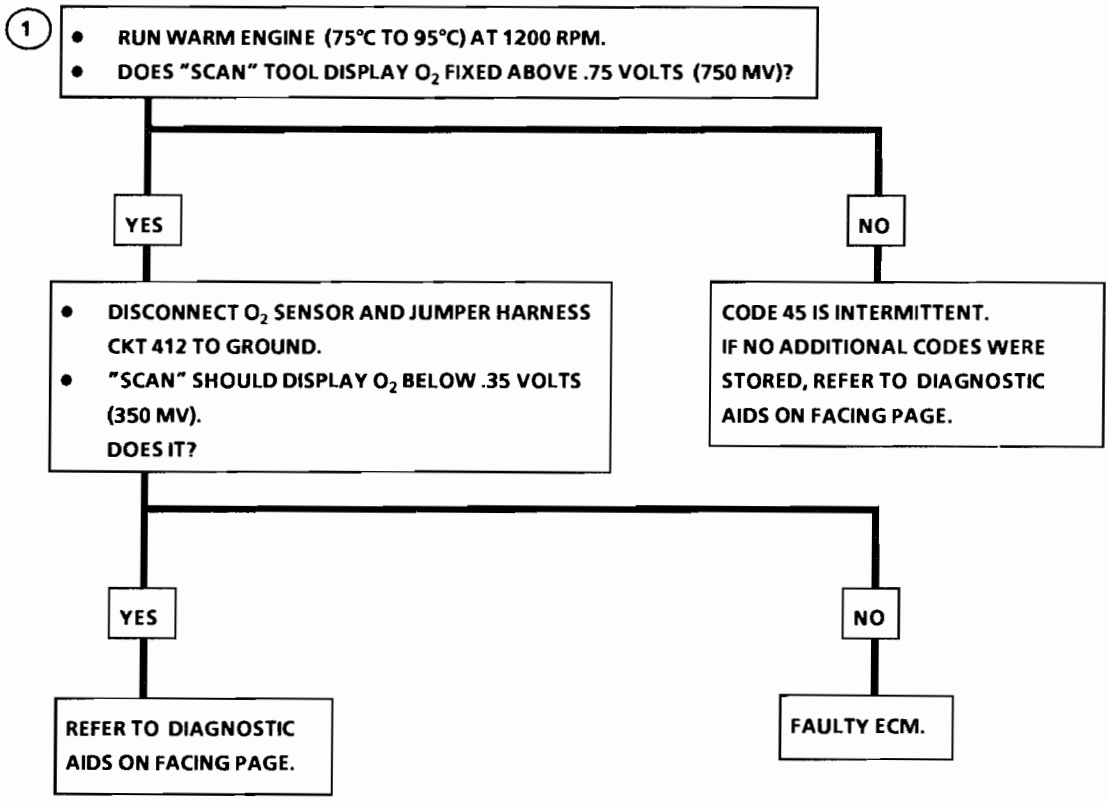
Using the "Scan", observe the block learn values at different rpm and air flow conditions. The "Scan" also displays the block cells, so the block learn values can be checked in each of the cells to determine when the Code 45 may have been set. If the conditions for Code 45 exist, the block learn values will be around 115.

- Fuel Pressure: System will go rich if pressure is too high. The ECM can compensate for some increase. However, if it gets too high, a Code 45 may be set. See Fuel System diagnosis, CHART A-7.
- Rich injector: Perform injector balance test, CHART C-2A.
- Leaking injector: See CHART A-7.
- Check for fuel contaminated oil.
- HEI Shielding: An open ground CKT 453 (ignition system reflow) may result in EMI, or induced electrical "noise". The ECM looks at this "noise" as reference pulses. The additional pulses result in a higher than actual engine speed signal. The ECM then delivers too much fuel, causing system to go rich. Engine tachometer will also show higher than actual engine speed, which can help in diagnosing this problem.
- Canister purge: Check for fuel saturation. If full of fuel, check canister control and hoses. See canister purge Section C3.
- MAF sensor: An output that causes the ECM to sense a higher than normal airflow can cause the system to go rich. Disconnecting the MAF sensor will allow the ECM to set a fixed value for the sensor. Substitute a different MAF sensor, if the the rich condition is gone while the sensor is disconnected.
- Check for leaking fuel pressure regulator diaphram by checking vacuum line to regulator for fuel.
- TPS: An intermittent TPS output will cause the system to go rich, due to a false indication of the engine accelerating.

"*SCAN*" DIAGNOSTICS

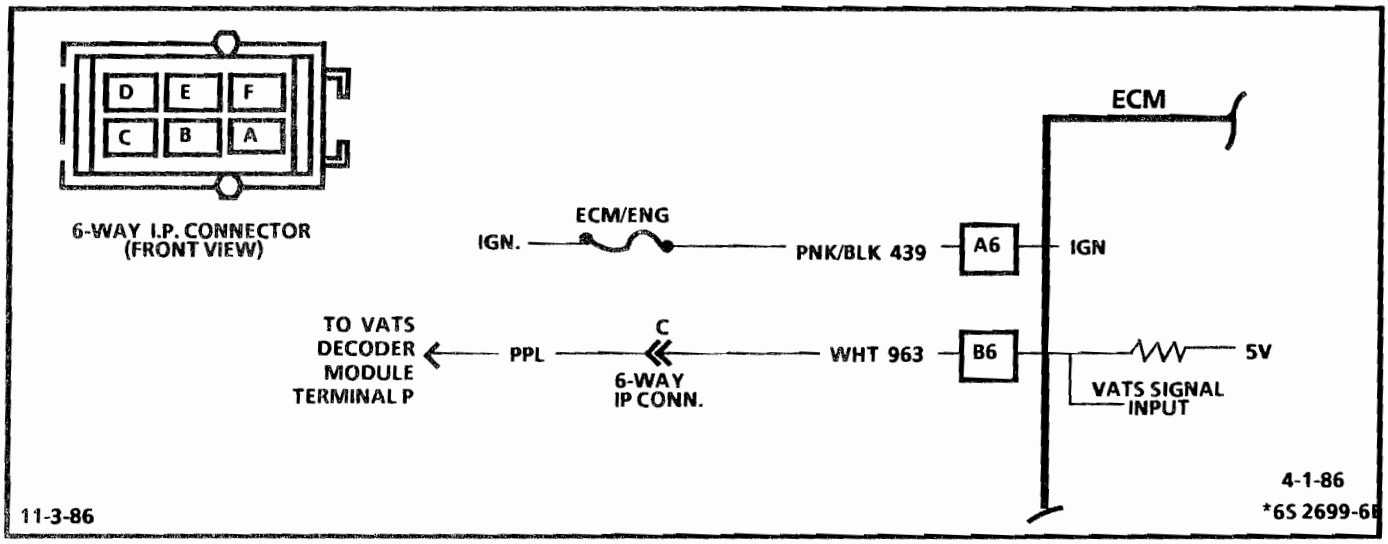
CODE 45

OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
5.7L "Y" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

9-5-86
*7S 3192



CODE 46

VEHICLE ANTI-THEFT SYSTEM (VATS) CIRCUIT 5.7L "Y" SERIES (PORT)

Circuit Description:

The VATS System is designed to disable vehicle operation if the incorrect key or starting procedure is used. The VATS decoder module sends a signal to the ECM if the correct key is being used. If the proper signal does not reach the ECM on CKT 963, the ECM will not pulse the injectors "ON" and thus not allow the vehicle to be started.

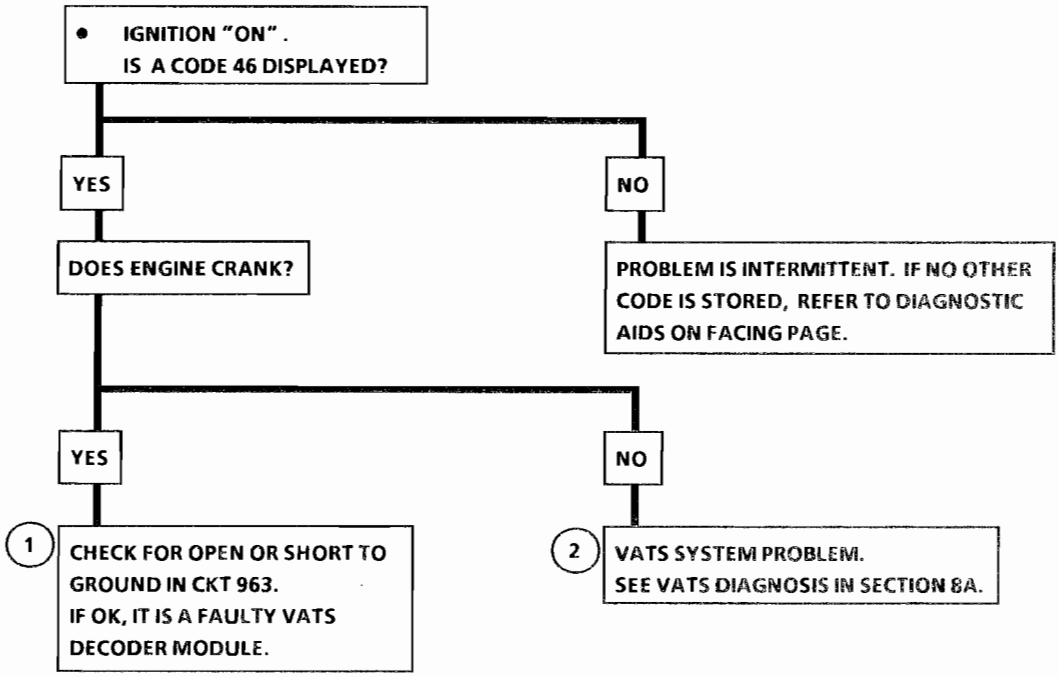
Code 46 will set, if the proper signal is not being received at ECM terminal "B6", when the ignition is turned "ON".

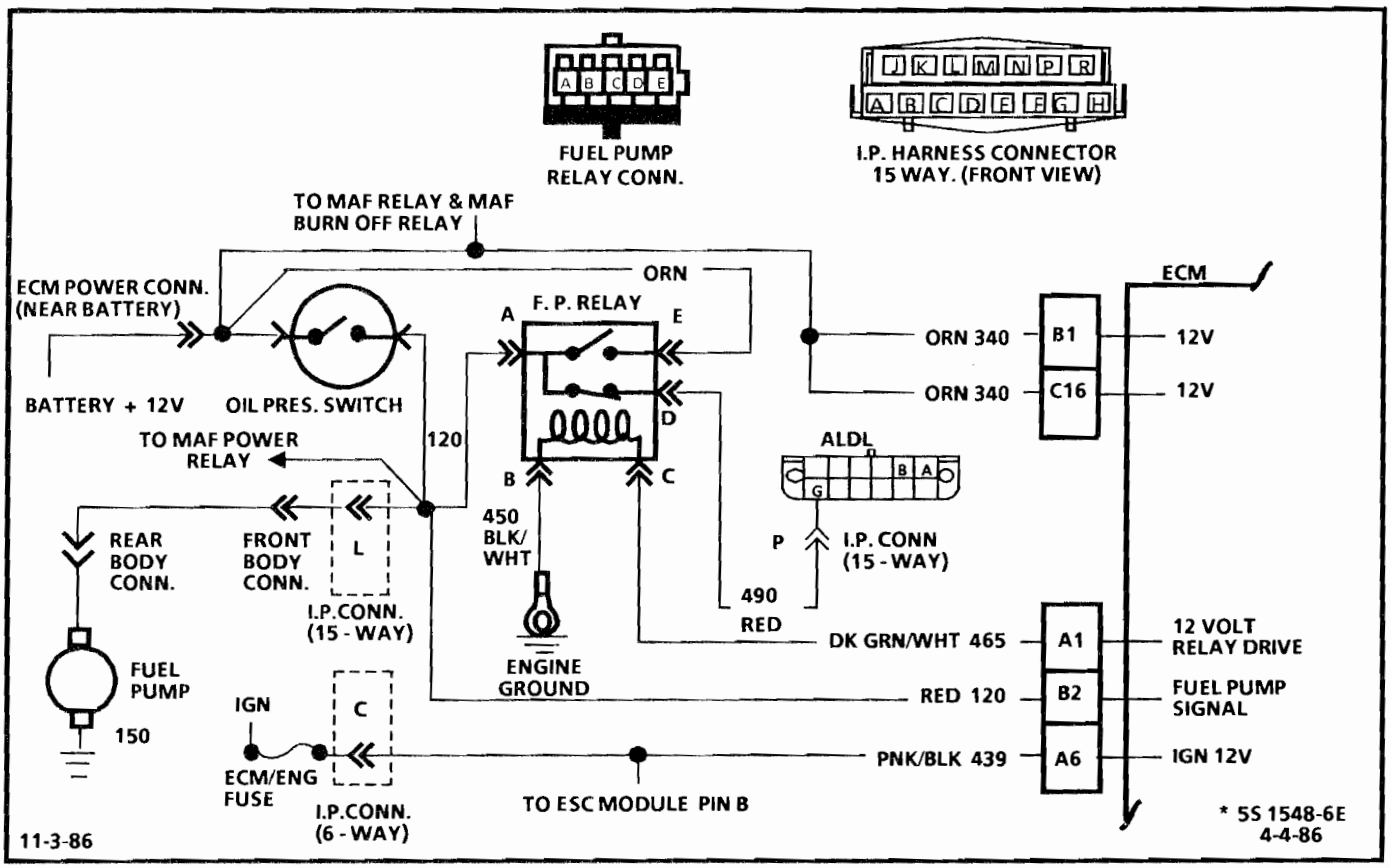
Test Description: Step numbers refer to step numbers on diagnostic chart.

1. If the engine cranks, and a Code 46 is stored, it indicates that the portion of the module which generates the signal to the ECM is not operating or the 963 CKT is open or shorted to ground. If the decoder module is found to be OK, as determined from Section "8A", the ECM may be at fault, but this is not a likely condition.
2. If Code 46 is stored, and the engine will not crank, it indicates that there is a VATS problem or an incorrect key or starting procedure is being used.

CODE 46

VEHICLE ANTI-THEFT SYSTEM (VATS) CIRCUIT 5.7 L "Y" SERIES (PORT)





CODE 54

FUEL PUMP CIRCUIT
(LOW VOLTAGE)
5.7L "Y" SERIES (PORT)

Circuit Description:

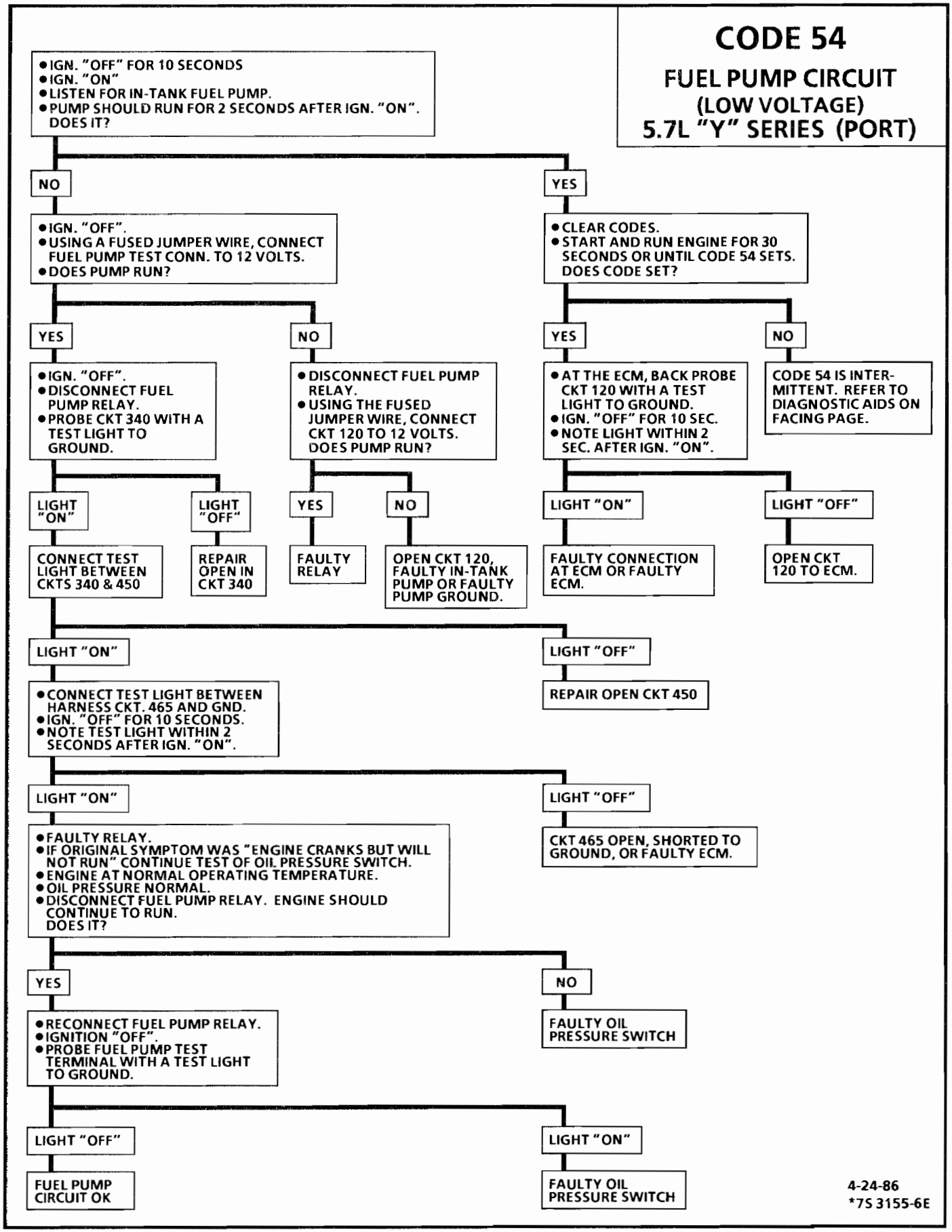
The status of the fuel pump CKT 120 (PPSW) is monitored by the ECM at terminal "B2" and is used to compensate fuel delivery based on system voltage. This signal is also used to store a trouble code, if the fuel pump relay is defective or fuel pump voltage is lost while the engine is running. There should be about 12 volts on CKT 120 for 2 seconds after the ignition is turned, or any time references pulses are being received by the ECM.

Code 54 will set, if the voltage at terminal "B2" is less than 2 volts for 1.5 seconds since the last reference pulse was received. This code is designed to detect a faulty relay, causing extended crank time, and the code will help the diagnosis of an engine that "CRANKS BUT WILL NOT RUN".

If a fault is detected during start-up the "Service Engine Soon" light will stay "ON" until the ignition is cycled "OFF". However, if the voltage is detected below 2 volts, with the engine running, the light will only remain "ON" while the condition exists.

CODE 54

FUEL PUMP CIRCUIT (LOW VOLTAGE) 5.7L "Y" SERIES (PORT)



CODE 51
CODE 52
CODE 53

5.7L "Y" SERIES (PORT)

CODE 51

FAULTY MEM-CAL

CHECK THAT ALL PINS ARE FULLY INSERTED IN THE SOCKET AND THAT MEM-CAL IS PROPERLY LATCHED. IF OK, REPLACE MEM/CAL, CLEAR MEMORY, AND RECHECK. IF CODE 51 REAPPEARS, REPLACE ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

CODE 52

FUEL CALPAK (Part of Mem-Cal) FAULT

CHECK THAT THE MEM-CAL IS FULLY SEATED AND LATCHED INTO THE MEM-CAL SOCKET. IF OK, REPLACE MEM-CAL, CLEAR MEMORY, AND RECHECK. IF CODE 52 REAPPEARS, REPLACE ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

CODE 53

SYSTEM OVER VOLTAGE

THIS CODE INDICATES THERE IS A BASIC GENERATOR PROBLEM.

- CODE 53 WILL SET, IF VOLTAGE AT ECM IGNITION INPUT PIN IS GREATER THAN 17.1 VOLTS FOR 2 SECONDS.
- CHECK AND REPAIR CHARGING SYSTEM. SEE SECTION 6D.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

9-16-86
*6S 2652-6E

SECTION B
SYMPTOMS

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Hard Start ..... Page B-3
Hesitation, Sag, Stumble ..... Page B-3
Surges and/or Chuggle ..... Page B-4
Lack of Power, Sluggish, or Spongy ..... Page B-4
Detonation/Spark Knock ..... Page B-5
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Backfire ..... Page B-6
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Dieseling, Run-On ..... Page B-6
Rough, Unstable, or Incorrect Idle, Stalling ..... Page B-7
Excessive Exhaust Emissions (Odors) ..... Page B-7
Restricted Exhaust System Check (Chart B-1) ..... Page B-8

SECTION B
SYMPTOMS

BEFORE STARTING

Before using this section you should have performed the DIAGNOSTIC CIRCUIT CHECK and found out that:

1. The ECM and "Service Engine Soon" light are operating.
2. There are no trouble codes stored, or there is a trouble code but no "Service Engine Soon" light.

Verify the customer complaint, and locate the correct SYMPTOM below. Check the items indicated under that symptom.

If the ENGINE CRANKS BUT WILL NOT RUN, see CHART A-3.

Several of the symptom procedures below call for a Careful Visual Check. This check should include:

- ECM grounds for being clean and tight
- Vacuum hoses for splits, kinks, and proper connections, as shown on Emission Control Information label.
- Air leaks at throttle body mounting and intake manifold.
- Air leaks between MAF sensor and throttle body.
- Ignition wires for cracking, hardness, proper routing, and carbon tracking.
- Wiring for proper connections, pinches, and cuts.

The importance of this step cannot be stressed too strongly - it can lead to correcting a problem without further checks and can save valuable time.

INTERMITTENTS

Problem may or may not turn "ON" the "Service Engine Soon" light, or store a code.

DO NOT use the Trouble Code Charts in Section "A" for intermittent problems. The fault must be present to locate the problem. If a fault is intermittent, use of Trouble Code Charts may result in replacement of good parts.

- Most intermittent problems are caused by faulty electrical connections or wiring. Perform careful check as described at start of Section "B". Check for:
  - Poor mating of the connector halves, or terminals not fully seated in the connector body (backed out).
  - Improperly formed or damaged terminals. All connector terminals in problem circuit should be carefully reformed to increase contact tension.
  - Poor terminal to wire connection. This requires removing the terminal from the connector body to check. See Introduction to Section "6E".
- If a visual check does not find the cause of the problem, the car can be driven with a voltmeter connected to a suspected circuit. A "Scan" tool can also be used for monitoring input signals to the ECM to help detect intermittent conditions. An abnormal voltage, or "Scan" reading, when the problem occurs, indicates the problem may be in that circuit. If the wiring and connectors check OK and a Trouble Code was stored for a circuit having a sensor, except for Codes 43, 44, and 45, substitute a known good sensor and recheck.

An intermittent "Service Engine Soon" light with no stored code may be caused by;

- Ignition coil shorted to ground and arcing at spark plug wires or plugs.
- "Service Engine Soon" light wire to ECM shorted to ground. (CKT 419).
- Diagnostic Test Terminal wire to ECM, shorted to ground.(CKT 451)
- ECM power grounds. See ECM wiring diagrams.
- Loss of trouble code memory. To check, disconnect TPS and idle engine until "Service Engine Soon" light comes "ON". Code 22 should be stored, and kept in memory, when ignition is turned "OFF". If not, the ECM is faulty.
- Check for an electrical system interference caused by a defective relay, ECM driven solenoid, or switch. They can cause a sharp electrical surge. Normally, the problem will occur when the faulty component is operated.
- Check for improper installation of electrical options, such as lights, 2-way radios, etc.
- EST wires should be kept away from spark plug wires, distributor wires, distributor housing, coil, and generator. Wire from ECM to distributor (CKT 453) should be a good connection.
- Check for open diode across A/C compressor clutch, and for other open diodes (see wiring diagrams).

HARD START

Definition: Engine cranks OK, but does not start for a long time. Does eventually run, or may start but immediately dies.

- Perform careful check as described at start of Section "B".
- Make sure driver is using correct starting procedure.
- **CHECK:**
  - TPS for sticking or binding or a high TPS voltage, with the throttle closed (should read less than .700 volts).
  - High resistance in coolant sensor circuit or sensor itself. See CODE 15 CHART OR with a "Scan" tool compare coolant temperature with ambient temperature on a cold engine.
  - Fuel pressure CHART A-7.
  - Water contaminated fuel.
  - EGR operation. Be sure valve seats properly and is not staying open. See CHART C-7.
  - Both injector fuses (visually inspect).
  - Ignition system - Check distributor for:
    Proper Output with ST-125.
    Worn shaft.
    Bare and shorted wires.
    Pickup coil resistance and connections.
    Loose ignition coil ground.
    Moisture in distributor cap.
- If problem exists in cold weather, check cold start valve. See CHART A-9 .
- A faulty in-tank fuel pump check valve will allow the fuel in the lines to drain back to the tank after the engine is stopped. To check for this condition:
  Perform Fuel System Diagnosis, CHART A-7.
- Remove spark plugs. Check for wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. Repair or replace as necessary.
- If engine starts, but then immediately stalls, open distributor bypass line. If engine then starts and runs OK, replace pickup coil.
- If engine starts and stalls, disconnect MAF sensor. If engine then runs and sensor connections are OK, replace the sensor.
- Basic engine problem.

HESITATION, SAG, STUMBLE

Definition: Momentary lack of response as the accelerator is pushed down. Can occur at all car speeds. Usually most severe when first trying to make the car move, as from a stop sign. May cause the engine to stall if severe enough.

- Perform careful visual check as described at start of Section "B".
- **CHECK:**
  - Fuel pressure. See CHART A-7. Also, Check for water contaminated fuel.
  - Air leaks at air duct between MAF Sensor and throttle body.
  - Spark plugs for being fouled or faulty wiring.
  - Mem-Cal number. Also check Service Bulletins for latest Mem-Cal.
  - TPS for binding or sticking. Voltage should increase at a steady rate as throttle is moved toward WOT.
  - Ignition timing. See Emission Control Information label.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - HEI ground, CKT 453.
  - Canister purge system for proper operation. See CHART C-3.
  - EGR - See CHART C-7.
- Perform injector balance test CHART C-2A.

SURGES AND/OR CHUGGLE

Definition: Engine power variation under steady throttle or cruise. Feels like the car speeds up and slows down with no change in the accelerator pedal.

- Be sure driver understands Transmission Converter Clutch and A/C compressor operation in Owner's Manual.
- Perform careful visual inspection as described at start of Section "B".
- **CHECK:**
  - Loose or leaking air duct between MAF sensor and throttle body.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - EGR - There should be no EGR at idle. See CHART C-7.
  - Vacuum lines for kinks or leaks.
  - Ignition timing. See Emission Control Information label.
  - In-line fuel filter. Replace if dirty or plugged.
  - Fuel pressure while condition exists. See CHART A-7.
- Inspect Oxygen sensor for silicon contamination from fuel, or use of improper RTV sealant. The sensor may have a white, powdery coating and result in a high but false signal voltage (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem.
- Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, or heavy deposits. Also check condition of distributor cap, rotor, and spark plug wires.
- To help determine if the condition is caused by a rich or lean system, the car should be driven at the speed of the complaint. Monitoring block learn at the complaint speed will help identify the cause of the problem. If the system is runnig lean (block learn greater than 138), refer to diagnostic aids on facing page of Code 44. If the system is running rich (block learn less than 118), refer to diagnostic aids on facing page of Code 45.

LACK OF POWER, SLUGGISH, OR SPONGY

Definition: Engine delivers less than expected power. Little or no increase in speed when accelerator pedal is pushed down part way.

- Perform careful visual check as described at start of Section "B".
- Compare customer's car to similar unit. Make sure the customer's car has an actual problem.
- Remove air cleaner and check air filter for dirt, or for being plugged. Replace as necessary.
- **CHECK:**
  - For loose or leaking air duct between MAF Sensor and throttle body.
  - Ignition timing. See Emission Control Information label.
  - Restricted fuel filter, contaminated fuel or improper fuel pressure. See CHART A-7.
  - ECM Ground circuits - See ECM wiring diagrams.
  - EGR operation for being open, or partly open all the time - CHART C-7.
  - Exhaust system for possible restriction: See CHART B-1.
    - Inspect exhaust system for damaged or collapsed pipes.
    - Inspect muffler for heat distress or possible internal failure.
  - For possible plugged pup convertor by comparing exhaust system backpressure on each side at engine. Check backpressure by removing A.I.R. check valves near exhaust manifolds. See CHART B-1 for procedure.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - Engine valve timing and compression.
  - Engine for proper or worn camshaft. See Section "6A".
  - Secondary voltage using a shop ocilliscope or a spark tester J-26792 (ST-125) or equivalent.

DETONATION /SPARK KNOCK

Definition: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening. Sounds like popcorn popping.

- Check for obvious overheating problems:
  - Low coolant.
  - Loose water pump belt.
  - Restricted air flow to radiator, or restricted water flow thru radiator.
  - Inoperative electric cooling fan circuit. See CHART C-12.
- **CHECK:**
  - Ignition timing. See Vehicle Emission Control Information label.
  - EGR system for not opening - CHART C-7.
  - TCC operation - CHART C-8.
  - Fuel system pressure. See CHART A-7.
  - Mem-Cal - Be sure it's the correct one. (See Service Bulletins).
  - Valve Oil seals for leaking.
- Check for incorrect basic engine parts such as cam, heads, pistons, etc.
- Check for poor fuel quality.
- Remove carbon with top engine cleaner. Follow instructions on can.
- Check ESC system
  See CHART C-5
- To help determine if the condition is caused by a rich or lean system, the car should be driven at the speed of the complaint. Monitoring block learn at the complaint speed will help identify the cause of the problem. If the system is runnig lean (block learn greater than 138), refer to diagnostic aids on facing page of Code 44. If the system is running rich (block learn less than 118), refer to diagnostic aids on facing page of Code 45.

CUTS OUT, MISSES

Definition: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. The exhaust has a steady spitting sound at idle or low speed.

- Perform careful visual check as described at start of Section "B".
- Check for missing cylinder by:
  1. Disconnect IAC valve. Start engine. Remove one spark plug wire at a time using insulated pliers.
  2. If there is an rpm drop on all cylinders (equal to within 50 rpm), go to ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING symptom. Reconnect IAC valve.
  3. If there is no rpm drop on one or more cylinders, or excessive variation in drop, check for spark on the suspected cylinder(s) with J 26792 (ST-125) Spark Gap Tool or equivalent. If no spark, see Section "6D" for Intermittent Operation or Miss. If there is spark, remove spark plug(s) in these cylinders and check for:
     - Cracks
     - Wear
     - Improper Gap
     - Burned Electrodes
     - Heavy Deposits
- Perform compression check on questionable cylinder(s) found above. If compression is low, repair as necessary. See Section "6".
- Disconnect all injector harness connectors. Connect J-34730-2 Injector Test Light or equivalent 6 volt test light between the harness terms, of each injector connector and note light while cranking. If test light fails to blink at any connector, it is a faulty injector drive circuit harness, connector, or terminal.
- Perform the Injector Balance Test. See CHART C-2A.
- **CHECK:**
  - Spark plug wires by connecting ohmmeter to ends of each wire in question. If meter reads over 30,000 ohms, replace wire(s).
  - Fuel System - Plugged fuel filter, water, low pressure. See CHART A-7.
  - Valve timing.
  - Secondary voltage using a shop ocilliscope or a spark tester J-26792 (ST-125) or equivalent.
- Visually inspect distributor cap and rotor for moisture, dust, cracks, burns, etc. Spray cap and plug wires with fine water mist to check for shorts.

- A miss condition can be caused by EMI (Electromagnetic Interference) on the reference circuit. EMI can usually be detected by monitoring engine rpm with a "Scan" tool. A sudden increase in rpm with little change in actual engine rpm change, indicates EMI is present.

  If the problem exists, check routing of secondary wires, check all distributor ground circuits, and be sure capacitor (located near the ignition module) is installed properly.
- Remove rocker covers. Check for bent pushrods, worn rocker arms, broken valve springs, worn camshaft lobes. Repair as necessary. See Section "6A".

BACKFIRE

Definition: Fuel ignites in intake manifold, or in exhaust system, making a loud popping noise.

- **CHECK:**
  - Loose wiring connector or air duct at MAF Sensor.
  - Compression - Look for sticking or leaking valves.
  - EGR operation for being open all the time. See CHART C-7.
  - EGR gasket for faulty or loose fit.
  - Valve timing.
  - Output voltage of ignition coil using a shop ocilliscope or spark tester J-26792 (ST-125) or equivalent.
  - Spark plugs for crossfire also inspect (distributor cap, spark plug wires, and proper routing of plug wires).
  - Ignition system for intermittent condition. (See Section "6D").
  - Engine timing - see Emission Control Information label.
  - Perform fuel system diagnosis check, CHART A-7A.
  - Perform injector balance test CHART C-2A.
  - A.I.R. System check valves - See Section "C-6".

POOR FUEL ECONOMY

Definition: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, economy is noticeably lower than it was on this car at one time, as previously shown by an actual road test.

- Perform careful visual check as described at start of Section "B".
- **CHECK:**
  - Coolant level.
  - Engine thermostat for faulty part (always open) or for wrong heat range. See Section "6B".
  - Compression.
  - Ignition timing. See Emission Control Information label.
  - TCC for proper operation. A "Scan" should indicate an rpm drop when the TCC is commanded "ON". See CHART C-8.
  - Induction system and crankcase for air leaks.
- Check for exhaust restriction
  See CHART B-1.

DIESELING, RUN-ON

Definition: Engine continues to run after key is turned "OFF", but runs very roughly. If engine runs smoothly, check ignition switch and adjustment.

- Check injectors for leaking. See CHART A-7.

ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING

Definition: The engine runs unevenly at idle. If bad enough, the car may shake. Also, the idle may vary in RPM (called "hunting"). Either condition may be bad enough to cause stalling. Engine idles at incorrect speed.

- Perform careful visual check as described at start of Section "B".
- **CHECK:**
  - Throttle linkage for sticking or binding.
  - Ignition timing. See Emission Control Information label.
  - ECM Ground circuits.
  - IAC system. See CHART C-2C.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - P/N switch circuit. See CHART C-1A, or use "Scan" Tool.
  - Injector balance. See CHART C-2A.
  - PCV valve for proper operation by placing finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve.
  - Evaporative Emission Control System. CHART C-3.
  - A/C Signal to ECM terminal "B8". "Scan" tool should indicate A/C is being requested when ever A/C is selected and the pressure cycling switch is closed.
  - Minimum idle speed. See Section "C2".
  - Loose or damaged MAF sensor duct between sensor and throttle body.
  - Check AIR System. There should be no AIR to ports while in closed loop. See CHART C6.
  - EGR valve: There should be no EGR at idle.
- Run a cylinder compression check-See Section "6".
- Inspect Oxygen sensor for silicon contamination from fuel, or use of improper RTV sealant. The sensor will have a white, powdery coating, and will result in a high but false signal voltage (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem.
- Check for fuel in pressure regulator hose. If present replace regulator assembly.
- Check ignition system; wires, plugs, rotor, etc.
- Check for loose or damaged air duct between MAF sensor and throttle body.
- Disconnect MAF sensor and if condition is corrected replace sensor.
- Clean Injectors.
- Monitoring block learn will help identify the cause of the problem. If the system is runnig lean (block learn greater than 138), refer to diagnostic aids on facing page of Code 44. If the system is running rich (block learn less than 118), refer to diagnostic aids on facing page of Code 45.

EXCESSIVE EXHAUST EMISSIONS (ODORS)

- If test shows higher than normal CO and HC, (also has excessive odors):
  - Check items which cause car to run RICH.
    - Make sure engine is at normal operating temperature.
- **CHECK:**
  - Fuel pressure. See CHART A-7.
  - Incorrect timing. See Vehicle Emission Control Information Label.
  - Canister for fuel loading. See CHART C-3.
  - Injector balance. See CHART C-2A.
  - PCV valve for being plugged, stuck, or blocked PCV hose.
  - Spark plugs, plug wires, and distributor cap. See Section "6D".
  - Check for lead contamination of catalytic converter (look for removal of fuel filler neck restrictor).
  - If the system is running rich, (block learn less than 118), refer to Diagnostic Aids on facing page of Code 45.
- IF TEST SHOWS EXCESSIVE NOx:
  - Check items which cause car to run LEAN, or to run too hot.
    - EGR valve for not opening. See CHART C-7.
    - Vacuum leaks.
    - Coolant system and coolant fan for proper operation. See CHART C-12.
    - Remove carbon with top engine cleaner. Follow instructions on can.
    - Check ignition timing for excessive base advance. See Emission Control Information label.
- If the system is running lean, (block learn greater than 138), refer to Diagnostic Aids on facing page of Code 44.

CHART B-1

RESTRICTED EXHAUST SYSTEM CHECK

ALL ENGINES

Proper diagnosis for a restricted exhaust system is essential before any components are replaced. Either of the following procedures may be used for diagnosis, depending upon engine or tool used:

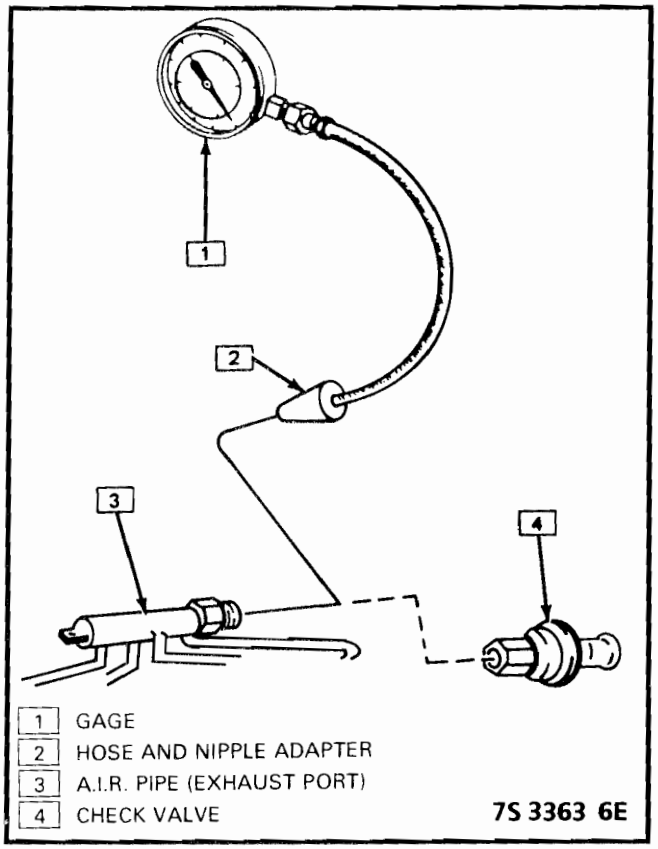
CHECK AT A. I. R. PIPE:

1. Remove the rubber hose at the exhaust manifold A.I.R. pipe check valve. Remove check valve.
2. Connect a fuel pump pressure gauge to a hose and nipple from a Propane Enrichment Device (J26911) (see illustration).
3. Insert the nipple into the exhaust manifold A.I.R. pipe.

OR

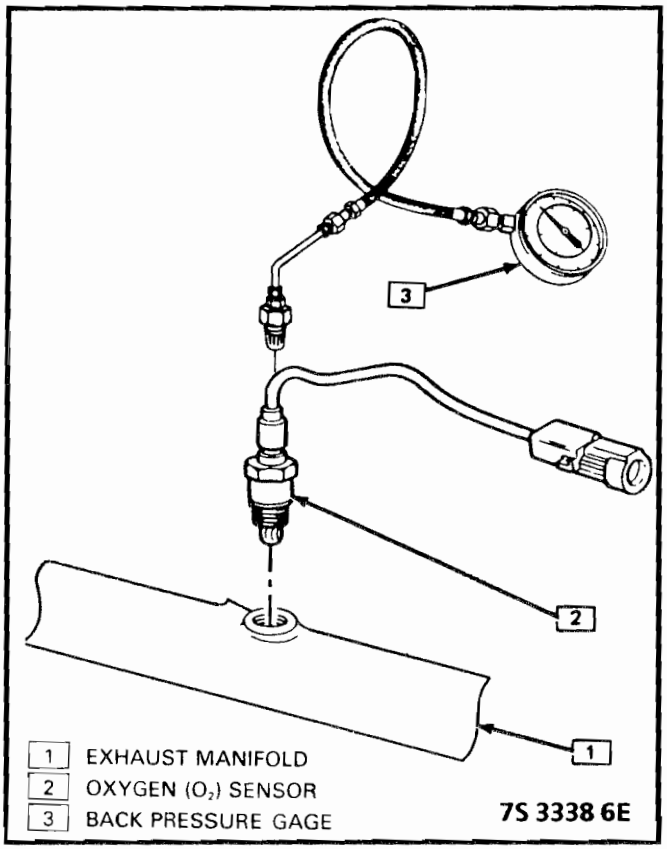
CHECK AT O_2 SENSOR:

1. Carefully remove O_2 sensor.
2. Install Borroughs Exhaust Backpressure Tester (BT 8515 or BT 8603) or equivalent in place of O_2 sensor (see illustration).
3. After completing test described below, be sure to coat threads of O_2 sensor with anti-seize compound P/N 5613695 or equivalent prior to re-installation.



1 GAGE
2 HOSE AND NIPPLE ADAPTER
3 A.I.R. PIPE (EXHAUST PORT)
4 CHECK VALVE

7S 3363 6E



1 EXHAUST MANIFOLD
2 OXYGEN (O_2) SENSOR
3 BACK PRESSURE GAGE

7S 3338 6E

DIAGNOSIS:

1. With the engine idling at normal operating temperature, observe the exhaust system backpressure reading on the gauge. Reading should not exceed 1 $\frac{1}{4}$ psi (8.6 kPa).
2. Accelerate engine to 2000 RPM and observe gauge. Reading should not exceed 3 psi (20.7 kPa).
3. If the backpressure, at either RPM, exceeds specification, a restricted exhaust system is indicated.
4. Inspect the entire exhaust system for a collapsed pipe, heat distress, or possible internal muffler failure.
5. If there are no obvious reasons for the excessive backpressure, a restricted catalytic converter should be suspected and replaced using current recommended procedures.

4-24-86

7S 3340-6E

Figure 13 Exhaust System Check

BLANK

SECTION C
COMPONENT SYSTEMS

Section C provides information on the following:

- General description of components and systems.
- On-vehicle service.
- Part names and group numbers.
- Diagnostic charts. These include a functional check of the system as well as diagnosis of any problem found in the functional check.

For locations of components, wiring diagrams, and ECM Terminal End View, refer to the front on the A Section of the engine being diagnosed.

Following are the sub-section identification and the system covered:

- C1 Electronic Control Module (ECM) and Sensors ..... **Page C1-1**
- C2 Fuel Control System ..... **Page C2-1**
- C3 Evaporative Emission Control System (EECS) ..... **Page C3-1**
- C4 Direct Ignition System/EST ..... **Page C4-1**
- C5 Electronic Spark Control ..... **Page C5-1**
- C6 Air Injection Reaction (AIR) System ..... **Page C6-1**
- C7 Exhaust Gas Recirculation (EGR) System ..... **Page C7-1**
- C8 Transmission Converter Clutch (TCC) ..... **Page C8-1**
- C12 Electric Cooling Fan ..... **Page C12-1**
- C13 Positive Crankcase Ventilation (PCV) ..... **Page C13-1**

DIAGNOSTIC CHARTS

The Diagnostic Charts for each system are found after the on-car service and parts information at the back of each section. Following are the charts found in this section.

- Chart C-1A Park Neutral Switch ..... **Page C1-10**
- Chart C-2A Injector Balance Test ..... **Page C2-16**
- Chart C-2C Idle Air Control (IAC) System Check ..... **Page C2-18**
- Chart C-3 Canister Purge Valve Check ..... **Page C3-4**
- Chart C-4A Ignition System Check ..... **Page C4-4**
- Chart C-5 Electronic Spark Control System Check ..... **Page C5-4**
- Chart C-6 AIR Management Check ..... **Page C6-6**
- Chart C-7 Exhaust Gas Recirculation (EGR) Check ..... **Page C7-4**
- Chart C-8A Automatic Transmission Converter Clutch (TCC) ..... **Page C8-6**
- Chart C-8B Manual Transmission (With Overdrive) Electrical Diagnosis ..... **Page C8-10**
- Chart C-12 Cooling Fan Control Circuit Diagnosis ..... **Page C12-2**

SECTION C1

ELECTRONIC CONTROL MODULE (ECM) AND SENSORS

CONTENTS

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GENERAL DESCRIPTION

ELECTRONIC CONTROL MODULE (ECM)

The Electronic Control Module (ECM) (Figure C1-1), located under the instrument panel, is the control center of the fuel injection system. It constantly looks at the information from various sensors, and controls the systems that affect vehicle performance. The ECM performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the "Service Engine Soon" light, and store a code or codes which identify the problem areas to aid the technician in making repairs. See "Introduction" for more information on using the diagnostic function of the ECM.

For service, this ECM only consists of two parts: a Controller (the ECM without a Mem-Cal) and an assembly called a Mem-Cal. (This stands for "Memory and Calibration" Unit).

MEM-CAL

This assembly contains both the functions of the PROM and CALPAK. Like the PROM, it contains the calibrations needed for a specific vehicle as well as the back-up fuel control circuitry required if the rest of the ECM becomes damaged or faulty.

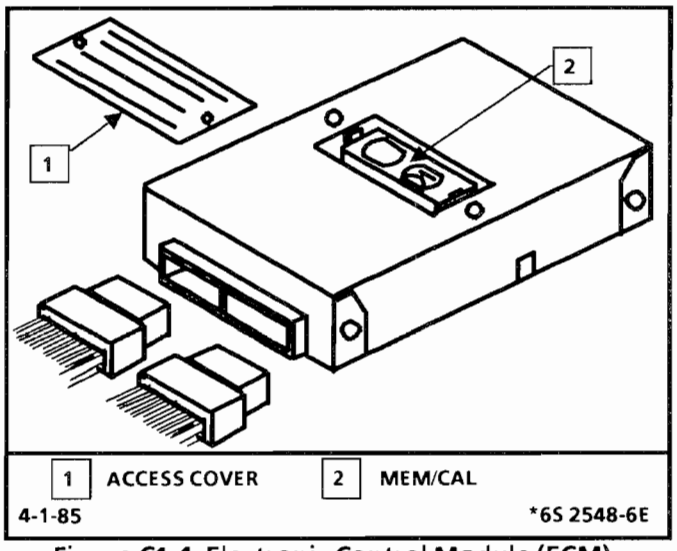


Figure C1-1 Electronic Control Module (ECM)

ECM Function

The ECM supplies either 5 or 12 volts to power various sensors or switches. This is done through resistances in the ECM which are so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, a 10 Meg Ohm input impedance digital voltmeter is required to assure accurate voltage readings.

The ECM controls output circuits such as the Injector, IAC, Cooling Fan Relay, etc. by controlling the ground circuit through transistors in the ECM.

INFORMATION SENSORS

Engine Coolant Temperature Sensor (Figure C1-3)

The coolant sensor is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at -40°C/-40°F), while high temperature causes low resistance (70 ohms at 130°C/266°F).

The ECM supplies a 5-volt signal to the coolant sensor through a resistor in the ECM and measures the voltage. The voltage will be high when the engine is cold, and low when the engine is hot. By measuring the voltage, the ECM knows the engine coolant temperature. Engine coolant temperature affects most systems the ECM controls.

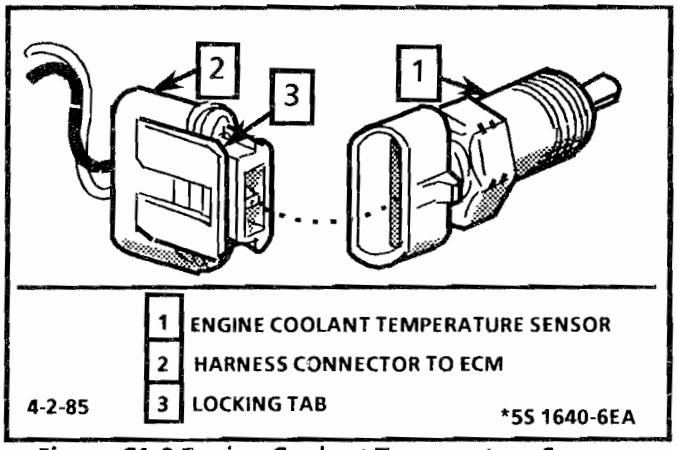


Figure C1-3 Engine Coolant Temperature Sensor

A failure in the coolant sensor circuit should set either a Code 14 or Code 15. Remember, these codes indicate a failure in the coolant temperature circuit, so proper use of the chart will lead to either repairing a wiring problem or replacing the sensor, to properly repair a problem.

Mass Air Flow (MAF) Sensor

The Mass Air Flow (MAF) sensor measures the amount of air which passes through it. The ECM uses this information to determine the operating condition of the engine, to control fuel delivery. A large quantity of air indicates acceleration, while a small quantity indicates deceleration or idle.

The Bosch Mass Air Flow (MAF) Sensor used in this vehicle is of the hot wire type. Current is supplied to the sensing wire to maintain a calibrated temperature, and as air flow increases or decreases the current will vary. This varying of current causes a

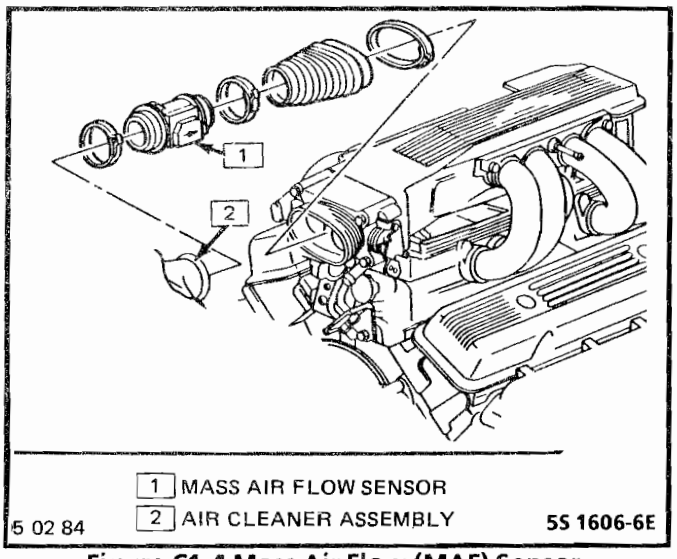


Figure C1-4 Mass Air Flow (MAF) Sensor

voltage drop within the meter circuitry which is directly proportional to air mass. The ECM supplies a current limiting 5-volt source on the signal line, and the MAF sensor pulls the voltage low (about .4V) with low air flow and up to about 5 volts with high air flow such as WOT. The voltage drop is then processed by the ECM for calculating fuel delivery. If the sensor fails, a Code 33 or 34 should be stored in memory.

Due to the sensor's hot wire being exposed to air, which always contains some contaminants, there can be deposits form on the sensing wire. This can affect the accuracy of the meters measurement. To keep the system functioning properly, the wire is heated to about 1000°F after engine shut down. This burn-off cycle is controlled by the ECM, which energizes the burn-off relay. The ECM will ground the relay winding after engine shut down, if the engine had been running a specified amount of time. With the relay energized, the ECM then monitors the MAF signal line to determine if the burn-off function took place. If it didn't, then a Code 36 will be stored and the "Service Engine Soon" light will come "ON" the next time the engine is started.

Manifold Air Temperature (MAT) Sensor

The Air Temperature Sensor (MAT) is a thermistor (a resistor which changes value based on temperature) is mounted in the plenum. Low temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

The ECM supplies a 5-volt signal to the sensor thru a resistor in the ECM and measures the voltage. The voltage will be high when the manifold air is cold, and low when the air is hot. By measuring the voltage, the ECM knows the manifold air temperature.

The MAT sensor signal is used by the ECM to delay EGR until the manifold air temperature reaches about 5°C (40°F).

A failure in the MAT sensor circuit should set either a Code 23 or Code 25.

Oxygen (O_2) Sensor (Figure C1-5)

The exhaust oxygen sensor (O_2) is mounted in the exhaust system, where it can monitor the oxygen content of the exhaust gas stream. The oxygen content in the exhaust reacts with the sensor to produce a voltage output. This voltage ranges from approximately .1 volt (high O_2 - lean mixture) to .9 volts (low O_2 - rich mixture). This voltage can be measured with a digital voltmeter having at least 10 Meg Ohms input impedance. Use of standard shop type voltmeters will result in very inaccurate readings.

By monitoring the voltage output of the O_2 sensor, the ECM will know what fuel mixture command to give to the Injector (lean mixture-low O_2 voltage = rich command, rich mixture-high O_2 voltage = lean command).

The O_2 sensor, if open, should set a Code 13. A low voltage in the sensor circuit should set a Code 44. A high voltage in the circuit should set a Code 45. Codes 44 and 45 could also be set as a result of fuel system problems. See Code Charts.

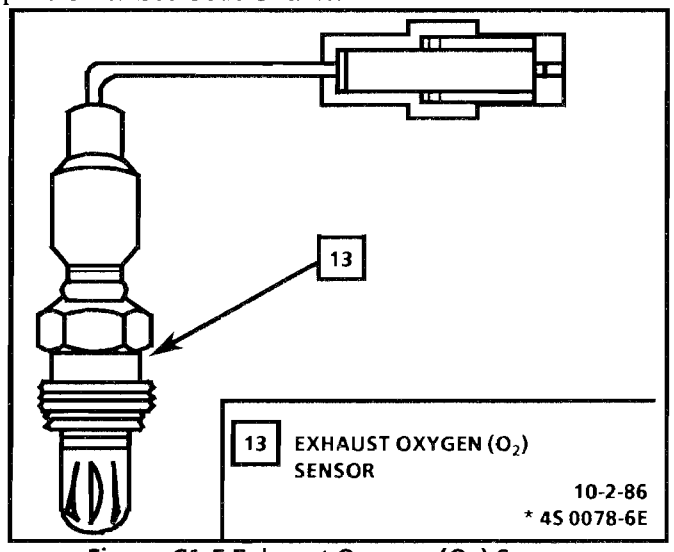


Figure C1-5 Exhaust Oxygen (O_2) Sensor

Throttle Position Sensor (TPS) (Figure C1-6)

The Throttle Position Sensor (TPS) is connected to the throttle shaft on the Throttle Body. It is a potentiometer with one end connected to 5 volts from the ECM and the other to ECM ground. A third wire is connected to the ECM to measure the voltage from the TPS. As the throttle valve angle is changed (accelerator pedal moved), the output of the TPS also changes. At a closed throttle position, the output of the TPS is low (approximately .5 volts). As the throttle valve opens, the output increases so that, at wide-open throttle, the output voltage should be approximately 5 volts.

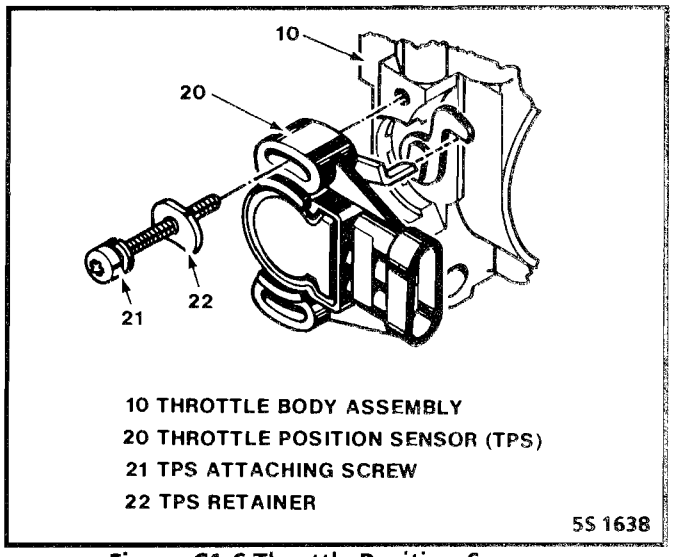


Figure C1-6 Throttle Position Sensor

By monitoring the output voltage from the TPS, the ECM can determine fuel delivery based on throttle valve angle (driver demand). A broken or loose TPS can cause intermittent bursts of fuel from the injector and an unstable idle, because the ECM thinks the throttle is moving. A problem in any of the TPS circuits will set either a Code 21 or 22. Once a Trouble Code is set, the ECM will use an artificial default value for TPS, and some vehicle performance will return.

See On-Car Service for replacement or adjustment of TPS.

Knock Sensor

This sensor is used to control engine detonation. Refer to Section "C5", for description.

Vehicle Speed Sensor

The Vehicle Speed Sensor (VSS), part of the digital cluster, sends a pulsing voltage signal to the ECM, which the ECM converts to miles per hour. This sensor mainly controls the operation of the TCC system. See "TCC System" for more information.

Park/Neutral Switch (Auto Only)

The Park/Neutral (P/N) switch indicates to the ECM when the transmission is in Park or Neutral. This information is used for the TCC and the IAC valve operation.

Important

Vehicle should not be driven with Park/Neutral switch disconnected, as idle quality will be affected and a possible false Code 24 (VSS).

See Section "8A" for more information on the P/N switch, which is part of the neutral/start and backup light switch assembly.

A/C "ON" Signal

This signal tells the ECM that the A/C selector Switch is turned "ON", and that the pressure cycling switch is closed. The ECM uses this to adjust the idle Speed when the air conditioning is working.

If this signal is not available to the ECM, idle may be rough, especially when the A/C compressor cycles. The voltage at ECM terminal "B8" should equal battery voltage on a C60 system and about 5 volts on a C68 option, when A/C is requested and the pressure cycling switch is closed.

Distributor Reference Signal

The distributor sends a signal to the ECM to tell it both engine rpm and crankshaft position. See Ignition System Section "C4" for further information.

DIAGNOSIS

To read the codes, use a "Scan" tool or ground the diagnostic terminal with the engine not running and the ignition "ON". The "Service Engine Soon" light will flash Code 12 three times and then flash each code stored in memory three times. All codes stored in memory would have been read when Code 12 was flashed again. No new codes can be stored when in the Diagnostics Mode (diagnostics lead grounded). This eliminates confusion while the system is being worked on.

To clear the codes from memory:

- Ignition "OFF".
- Disconnect battery pigtail, located near the battery, for 30 seconds.

Since the ECM can have a failure which may affect only one circuit, following the Diagnostic Procedures in this section will determine which circuit has a problem and where it is.

If a diagnostic chart indicates that the ECM connections or ECM is the cause of a problem,and the ECM is replaced, but does not correct the problem, one of the following may be the reason:

- There is a problem with the ECM terminal connections. - The diagnostic chart will say "ECM connections or ECM. The terminals may have to be removed from the connector in order to check them properly.
- The ECM, or Mem-Cal is not correct for the application. - The incorrect components may cause a malfunction and may or may not set a code.
- The problem is intermittent. - This means that the problem is not present at the time the system is being checked. In this case, refer to the "Symptoms" portion of the manual and make a careful physical inspection of all portions of the system involved.
- Shorted solenoid, relay coil, or harness. - Solenoids and relays are turned "ON" and "OFF" by the ECM, using internal electronic switches called "Drivers". Each driver is part of a group of four called "Quad-drivers". Failure of one driver can damage any other driver in the set. A shorted solenoid, relay coil, or harness, with a GMP4 computer, will not damage the ECM, but will cause the component to be inoperative.
  J34636 or BT 8405 testers or equivalent provide a fast, accurate means of checking for a shorted coil or a short to battery voltage.
- The Mem-Cal may be faulty. - Although these rarely fail, it operates as part of the ECM. Therefore, it could be the cause of the problem. Substitute a known good Mem-Cal.
- The replacement ECM may be faulty - After the ECM is replaced, the system should be rechecked for proper operation. If the diagnostic chart again indicates the ECM is the problem, substitute a known good ECM. Although this is a rare condition, it could happen.

ECM

A faulty ECM will be determined in the diagnostic charts, or by a Code 55.

MEM-CAL

An incorrect or faulty Mem-Cal, which is part of the ECM, may set a Code 41 or 51. Also, be sure Mem-Cal is fully seated and latched in the socket.

ECM Inputs

All of the sensors and input switches can be diagnosed by the use of a "Scan" tool. Following is a short description of how the sensors and switches, can be diagnosed by the use of "Scan". The "Scan" can also be used to compare the values for a normal running engine with the engine you're diagnosing.

Coolant Temperature Sensor

A "Scan" tool displays engine temp. in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C then stabilize when thermostat opens. If the engine has not been run for several hours (overnight), the coolant temperature and MAT temperatures should read close to each other. A fault in the coolant sensor circuit should set a Code 14 or 15. The code charts also contain a chart to check for sensor resistance values relative to temperature.

MAF Sensor

A "Scan" tool reads the MAF value and displays it in grams per second. Should read between 4-7 on a fully warmed up idling engine. Values should change rather quickly on acceleration, but values should remain fairly stable at any given RPM. Most "Scan" tools will have 2 positions for reading MAF sensor values (MAF & Air Flow). Both values should read the same if no Code 33 or 34 is set, but if a code is set, the MAF values will be the default value and the Air Flow parameter will lock in on the value to which the ECM recognized the fault. A failure in the MAF sensor or circuit should set a Code 33 or 34.

MAT Sensor

A "Scan" tool displays temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rise as underhood temperature increases. If the engine has not been run for several hours (overnight) the MAT sensor temperature and coolant temperature should read close to each other. A failure in the MAT sensor circuit should set a Code 23 or 25. The code charts also contain a chart to check for sensor resistance values relative to temperature.

O_2 Sensor

The "Scan" has several positions that will indicate the state of the exhaust gases, O_2 voltage, integrator, and block learn. See "Scan" position information in Introduction. Section "6E".

A problem in the O_2 sensor circuit or fuel system should set a Code 13 (open circuit), Code 44 (lean indication), Code 45 (rich indication). Refer to applicable chart if any of these codes were stored in memory.

TPS

A "Scan" tool displays throttle position in volts. The 5.7L should read .54V ± .075V, with throttle closed and ignition "ON", or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT.

The ECM has the ability to Auto-Zero the TPS voltage if it is below about .7V (700mv). This means that any voltage less than .7 volts will be determined by the ECM to be 0% throttle. A failure in the TPS or circuit should set a Code 21 or 22.

VSS

A "Scan" tools reading should closely match with speedometer reading with drive wheels turning. A failure in the VSS circuit should set a Code 24.

P/N Switch

A "Scan" tool should read "P/N" when in Park or Neutral and "R.D.L." when in Drive. This reading may vary with different makes of tools. Refer to Chart C-1A for P/N switch diagnosis.

A/C Request Signal

"Scan" tool should indicate A/C "ON", when A/C is requested and the pressure cycling switch is closed.

Reference Signal

A "Scan" tool will read this signal and is displayed in rpm. See Section "C4" for more information on the Ignition System.

ON-CAR SERVICE

ELECTRONIC CONTROL MODULE (ECM)

Service of the ECM should, normally, consist of either replacement of the ECM or a Mem-Cal change.

If the diagnostic procedures call for the ECM to be replaced, the engine calibrator (Mem-Cal) and ECM should be checked first to see if they are the correct parts. If they are, remove the Mem-Cal from the faulty ECM and install it in the new service ECM. THE SERVICE ECM WILL NOT CONTAIN A MEM-CAL. Trouble Code 51 indicates the Mem-Cal is installed improperly or has malfunctioned. When Code 51 is obtained, check the Mem-Cal installation for bent pins or pins not fully seated in the socket. If it is installed correctly and Code 51 still shows, replace the Mem-Cal.

Important

When replacing the production ECM with a service ECM (controller), it is important to transfer the Broadcast code and production ECM number to the service ECM label. Please do not record on ECM cover. This will allow positive identification of ECM parts throughout the service life of the vehicle.

Important

To prevent internal ECM damage, the ignition must be "OFF", when disconnecting or reconnecting power to ECM (for example, battery cable, ECM pigtail, ECM fuse, jumper cables, etc.).

ECM OR MEM-CAL REPLACEMENT

Remove or Disconnect

1. Negative Battery Cable.
2. Right Hand Kick Panel.

3. Connectors from ECM.
4. ECM Mounting hardware.
5. ECM from Passenger Compartment.
6. ECM Access Cover. (Figure C1-11)
7. Mem-Cal Removal. (Figure C1-12)

Important

Replacement ECM is supplied without a Mem-Cal, so care should be used when removing it from the defective ECM because it will be reused in the new ECM.

Using two fingers, push both retaining clips back away from the Mem-Cal. At the same time, grasp it at both ends and lift it up out of the socket. Do not remove the cover of the Mem-Cal. Use of unapproved Mem-Cal removal methods may cause damage to the Mem-Cal or socket.

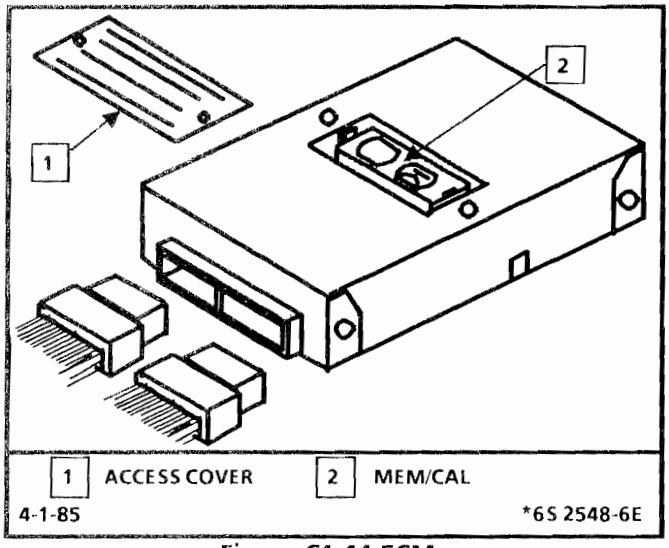


Figure C1-11 ECM

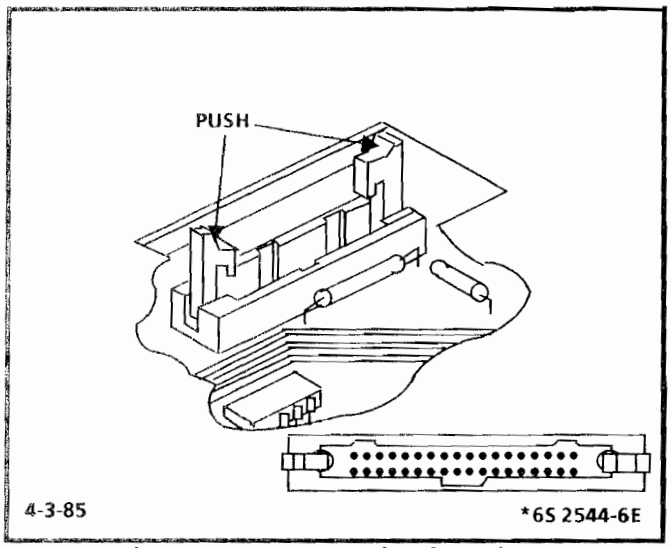


Figure C1-12 Mem/Cal Unit Socket

Inspect (Figure C1-13)

For alignment notches of the Mem-Cal and carefully set it aside. Do not open the Mem-Cal.

IF ECM IS BEING REPLACED:

Remove or Disconnect

1. New ECM from its packaging and check the service number to make sure it is the same as the defective ECM.
2. Access Cover.

Install or Connect

1. Mem-Cal in Mem-Cal Socket.

Important

Press only on the ends of the Mem-Cal.
Small notches in the Mem-Cal must be aligned with the small notches in the Mem-Cal socket. Press on the ends of the Mem-Cal until the retaining clips snap into the ends of the Mem-Cal. Do not press on the middle of the Mem-Cal, only on the ends.

2. Access cover on ECM.
3. ECM in passenger compartment.
4. Connectors to ECM.

Functional Check

1. Turn ignition "ON".
2. Enter diagnostics.
   A. Code 12 should flash four times (If no other codes are present). This indicates the Mem-Cal is installed properly and the ECM is functioning.
   B. If trouble Code 51 occurs, or if the "Service Engine Soon" light is "ON" constantly with no codes, the Mem-Cal is not fully seated or is defective.
      - If not fully seated, press firmly on the ends of the Mem-Cal.
      - If it is necessary to remove the Mem-Cal, follow the previous removal instructions.

COOLANT SENSOR

NOTICE: Care must be taken when handling coolant sensor. Damage to coolant sensor will affect proper operation of the Fuel Injection system.

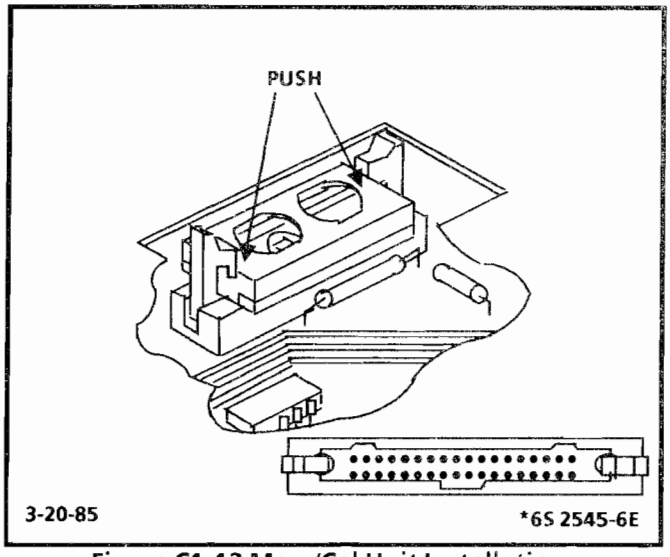


Figure C1-13 Mem/Cal Unit Installation

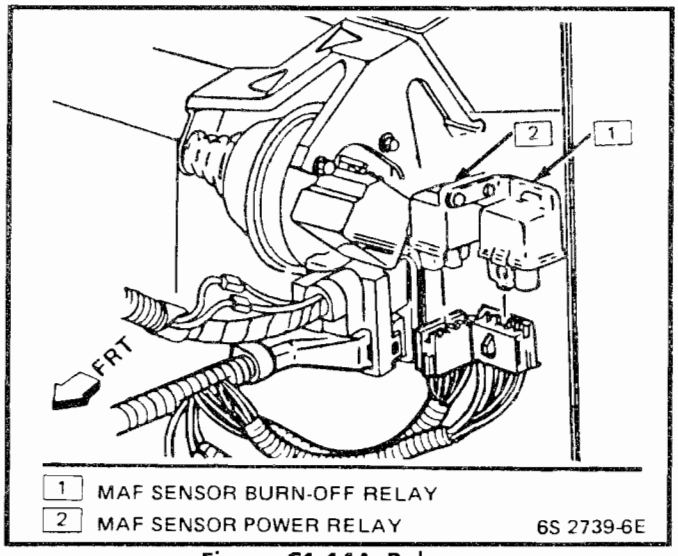


Figure C1-14A Relays

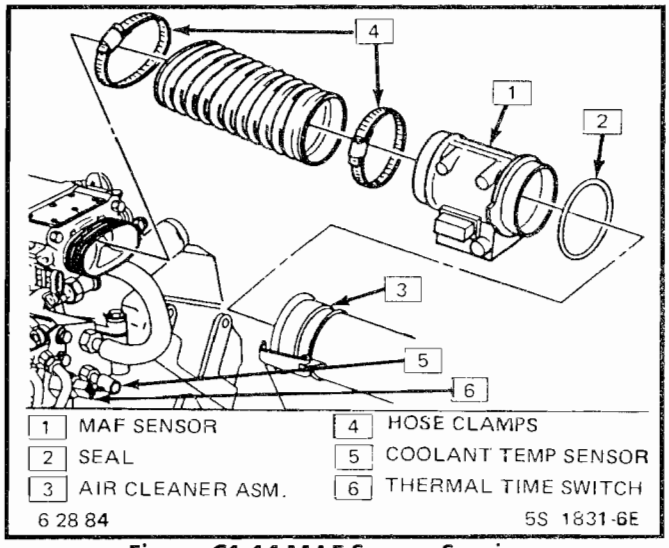


Figure C1-14 MAF Sensor Service

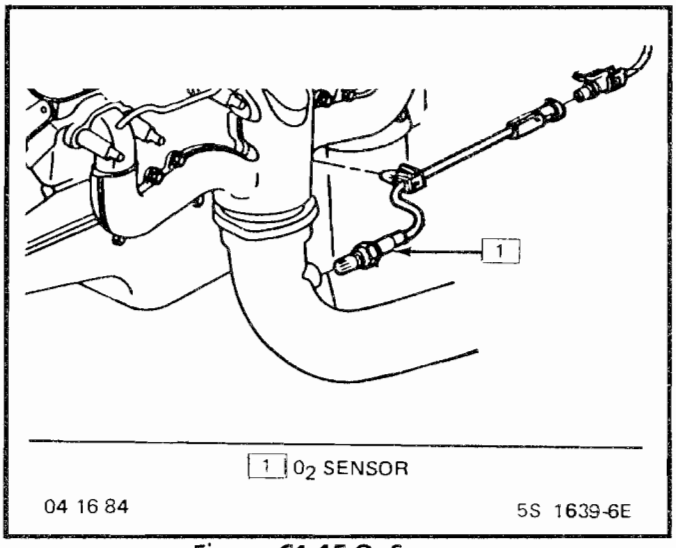


Figure C1-15 O_2 Sensor

Remove or Disconnect

1. Negative battery cable.
2. Air inlet duct.
3. Diverter valve bracket.
4. Electrical connector.
5. Carefully back out coolant sensor.

Install or Connect

1. Sensor in engine.
2. Electrical connector.
3. Diverter valve bracket.
4. Air inlet tube.
5. Negative battery cable.

MAF SENSOR

Replacement of the MAF sensor is shown in Figure C1-14.

MAF SENSOR POWER & BURN-OFF RELAY

Refer to Figure C1-14A for relay location.

OXYGEN SENSOR

NOTICE: The oxygen sensor uses a permanently attached pigtail and connector. This pigtail should not be removed from the oxygen sensor. Damage or removal of the pigtail or connector could affect proper operation of the oxygen sensor.

Important

Take care when handling the oxygen sensor. The in-line electrical connector and louvered end must be kept free of grease, dirt, or other contaminants. Also, avoid using cleaning solvents of any type. Do not drop or roughly handle the oxygen sensor.

Remove or Disconnect

The oxygen sensor may be difficult to remove when engine temperature is below 48°C (120°F).

Excessive force may damage threads in exhaust manifold or exhaust pipe.

1. Negative battery cable.
2. Electrical connector.
3. Carefully back out Oxygen Sensor.

Install or Connect

Important

A special anti-seize compound is used on the oxygen sensor threads. The compound consists of a liquid graphite and glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove.

New, or service, sensors will already have the compound applied to the threads. If a sensor is removed from an engine, and, if for any reason it is to be reinstalled, the threads must have anti-seize compound applied before reinstallation.

1. Coat threads of oxygen sensor with anti-seize compound P/N 5613695, or equivalent, if necessary.
2. Sensor, and torque to 41 N•m (30 ft. lbs.).
3. Electrical connector.
4. Negative battery cable.

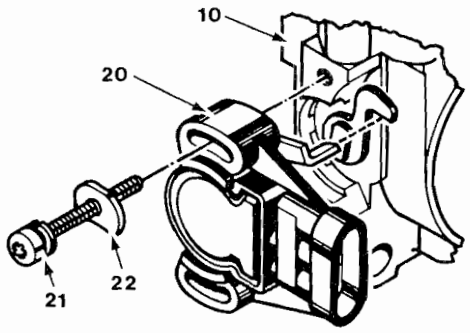
THROTTLE POSITION SENSOR (TPS)

Remove or Disconnect

1. Electrical connector.
2. Two TPS attaching screws and retainers.
3. Sensor.

Install or Connect

1. With throttle valve in the normal closed idle position, install Throttle Position Sensor on throttle body assembly, making sure TPS pickup lever lines up with tang on throttle actuator lever. (See Figure C1-16)
2. Retainers and two TPS screws. DO NOT tighten screws until TPS is adjusted.



10 THROTTLE BODY ASSEMBLY
20 THROTTLE POSITION SENSOR (TPS)
21 TPS ATTACHING SCREW
22 TPS RETAINER
5S 1638-6E

Figure C1-16 Throttle Position Sensor Service

Adjust

1. Install "Scan" tool.
2. With ignition "ON", adjust TPS to obtain .54 volts ± .08 volts.
3. Tighten screws, then recheck reading to insure adjustment has not changed.

PARK/NEUTRAL SWITCH

See Section "8A" for location of Park/NeutralSwitch. On-Car Service and Adjustment Procedures are also listed there.

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM	3.670
Memory Calibration Unit, Mem/Cal	3.670
Sensor, Coolant Temp	3.682
Sensor, Exhaust Oxygen	3.682
Sensor, Manif Air Temp (MAT)	3.682
Sensor, Mass Air Flow (MAF)	3.682
Relay - MAF Burn-Off	3.682
Relay - MAF Power	3.682
Sensor, Throttle Position: Part of Sensor Kit, Throttle Position	3.440
Sensor, Vehicle Speed	3.682

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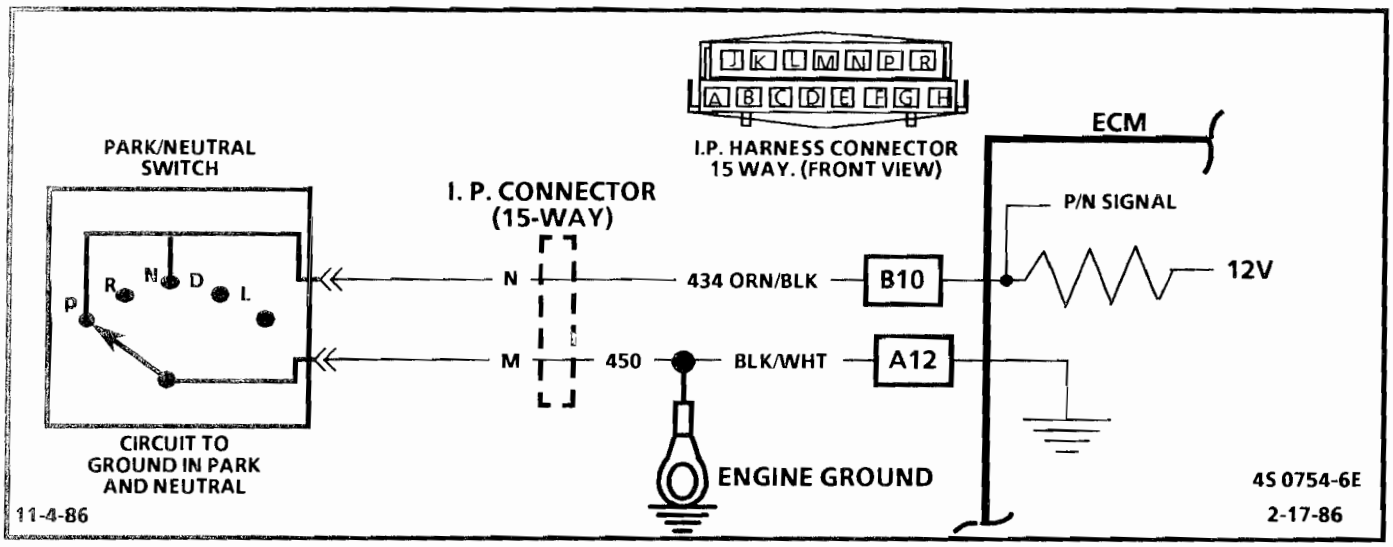


CHART C-1A

PARK/NEUTRAL SWITCH
(AUTO TRANSMISSION ONLY)
5.7L "Y" SERIES (PORT)

Circuit Description:

The Park/Neutral Switch contacts are a part of the Neutral Start switch, and are closed to ground in park or neutral and open in drive ranges.

The ECM supplies ignition voltage, through a current limiting resistor, to CKT 434 and senses a closed switch, when the voltage on CKT 434 drops to less than one volt.

The ECM uses the P/N signal as one of the inputs to control:

Idle Air Control
VSS Diagnostics
EGR

If CKT 434 indicates P/N (grounded), while in drive range, the EGR would be inoperative, resulting in possible detonation.

If CKT 434 always indicates drive (open), a drop in the idle may exist when the gear selector is moved into drive range.

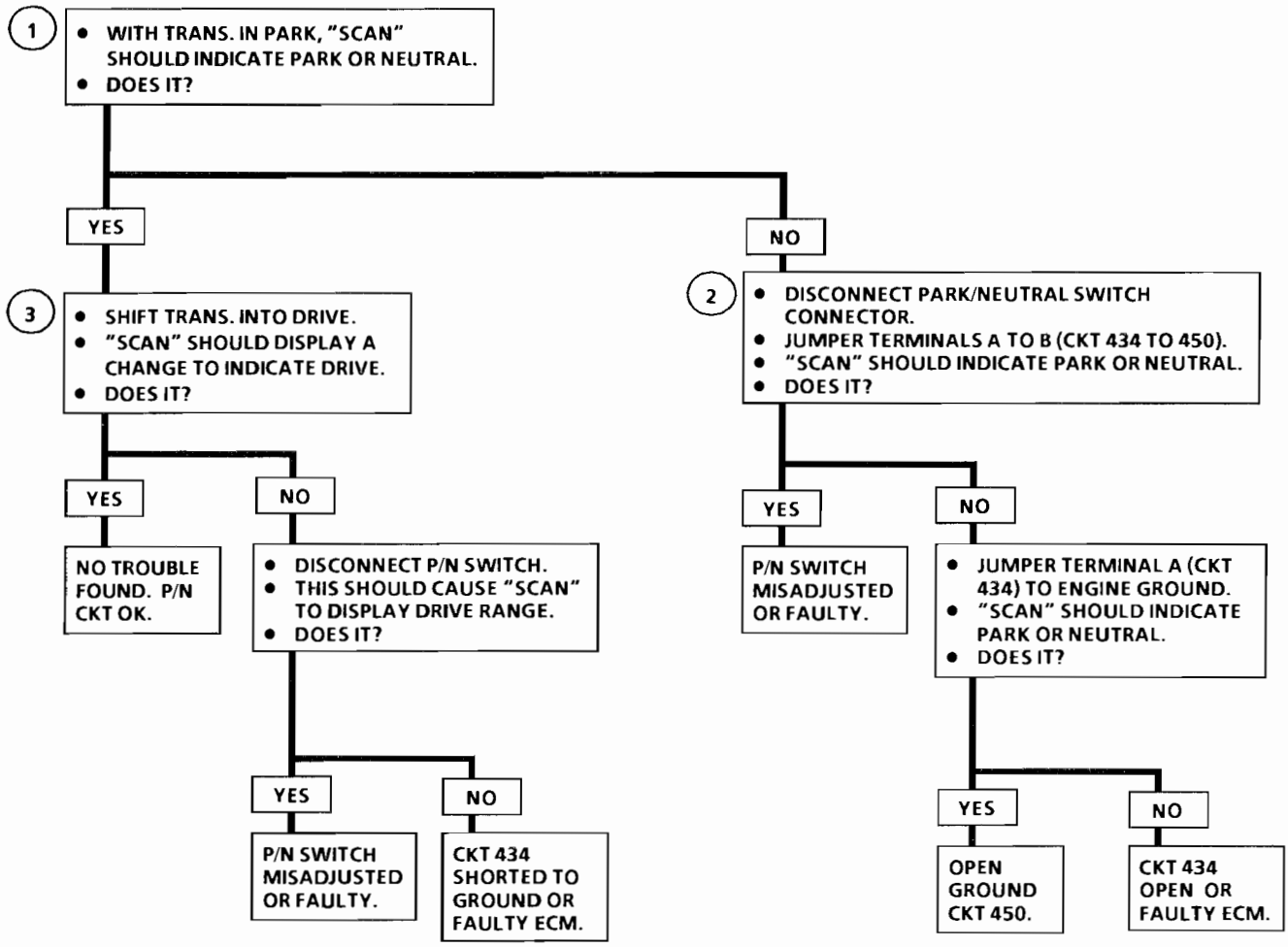
Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Checks for a closed switch to ground in park position. Different makes of "Scan" tools will read P/N differently. Refer to operators manual for type of display used for a specific tool.
2. Checks for an open switch in drive range.
3. Be sure "Scan" indicates drive, even while wiggling shifter to test for a. intermittent or misadjusted switch in drive range.

"SCAN" DIAGNOSTICS

CHART C-1A

PARK/NEUTRAL SWITCH DIAGNOSIS
(AUTO TRANSMISSION ONLY)
5.7L "Y" SERIES (PORT)



5-19-86
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SECTION C2

FUEL CONTROL SYSTEM

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GENERAL DESCRIPTION

PURPOSE

The basic function of the fuel control system is to control fuel delivery to the engine.

Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold near each cylinder.

The main control sensor is the Oxygen (O_2) Sensor, which is located in the exhaust manifold. The O_2 sensor tells the Electronic Control Module (ECM) how much oxygen is in the exhaust gas. The ECM changes the Air/Fuel ratio to the engine by controlling the fuel injectors. The best mixture to minimize exhaust emissions is 14.7 to 1, which allows the Catalytic Converter to operate the most efficiently. Because of the constant measuring and adjusting of the air/fuel ratio, the Fuel Injection system is called a "Closed Loop" System (shown in Figure C2-1).

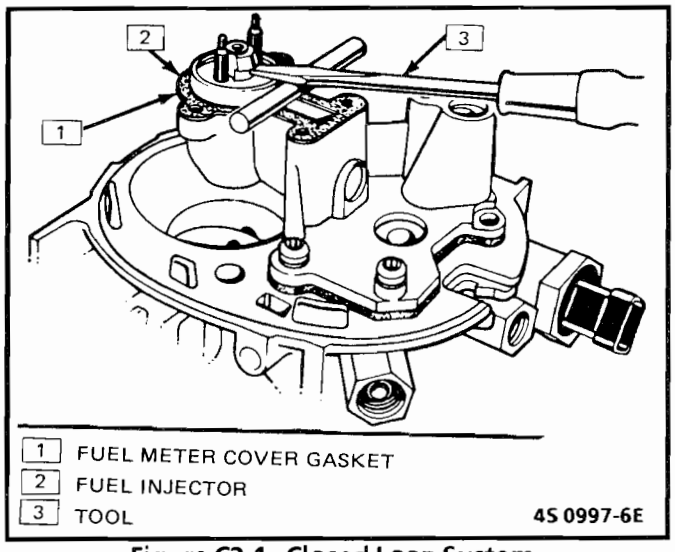


Figure C2-1 Closed Loop System

MODES OF OPERATION

The ECM looks at voltages from several sensors to determine how much fuel to give the engine. The fuel is delivered under one of several conditions, called "modes". All the modes are controlled by the ECM, and are described below.

Starting Mode

When the ignition is first turned "ON", the ECM will turn "ON" the fuel pump relay for two seconds, and the fuel pump will build up pressure. The ECM then checks the coolant temperature sensor, throttle position sensor, and determines the proper air / fuel ratio for starting. This ranges from 1.5 : 1 at -36°C (-33°F) to 14.7 : 1 at 94°C (201°F). The ECM controls the amount of fuel delivered in the Starting Mode by changing how long the injectors are pulsed "ON".

The Cold Start Valve (Figure C2-2), not controlled by the ECM, is used to provide additional fuel during the starting mode to improve cold start-ups. This circuit is important, when the engine coolant temperature is very low, because the other injectors would not be pulsed "ON" long enough to provide the needed amount of fuel to start. The Cold Start Valve is somewhat different from the other injectors in that it causes the fuel to be vaporized for a better combustionable mixture.

The circuit is activated only in the crank mode. The power is supplied directly from the starter solenoid and is protected by the crank fuse. The system is controlled by a Cold Start Fuel Injection Switch which provides a ground path for the valve during cranking whenever engine coolant is below 35° C (95°F).

The Cold Start Fuel Injection Switch contains a bimetal switch which opens the circuit at specified coolant temperature. This bimetal is also heated by the winding in the Switch, which would allow the valve to stay "ON" 8 seconds at -20° C or below. The time the switch stays closed varies inversely with coolant temperature. In other words, as the coolant temperature goes up the maximum cold start valve "ON" time goes down.

Clear Flood Mode

If the engine floods, clear it by pushing the accelerator pedal down all the way. The ECM then pulses the injectors at an air/fuel ratio of 20:1. The ECM holds this injector rate as long as the throttle stays wide open, and the engine rpm is below 600. If the throttle position becomes less than 80%, the ECM returns to the Starting Mode.

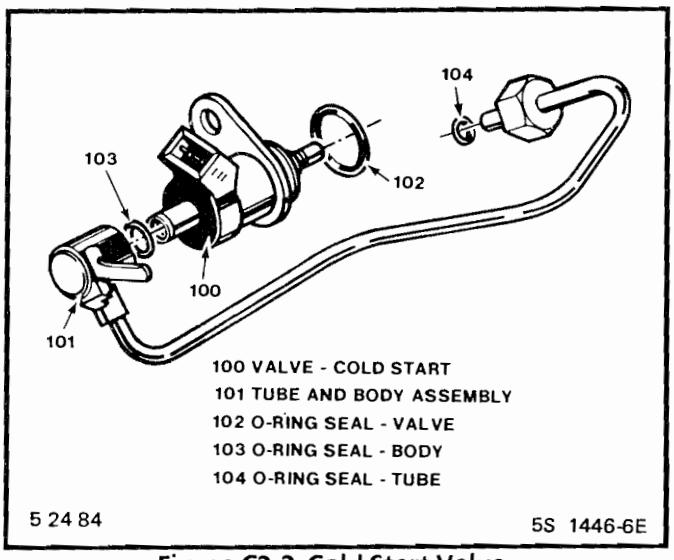


Figure C2-2 Cold Start Valve

Run Mode

The RUN mode has two conditions called "Open Loop" and "Closed Loop".

When the engine is first started, and rpm is above 400 rpm, the system goes into "Open Loop" operation. In "Open Loop", the ECM will ignore the signal from the Oxygen (O_2) sensor, and calculate the air/fuel ratio based on inputs from the Coolant and MAF sensors.

The system will stay in "Open Loop" until the following conditions are met:

1. The O_2 sensor has varying voltage output, showing that it is hot enough to operate properly. (This depends on temperature.)
2. The Coolant Sensor is above a specified temperature about 40°C (104°F).
3. A specific amount of time has elapsed after starting the engine.

The specific values for the above conditions vary with different engines, and are stored in the Mem-Cal. When these conditions are met, the system goes into "Closed Loop" operation. In "Closed Loop", the ECM will calculate the air/fuel ratio (injector on-time) based on the signal from the O_2 sensor. This allows the air / fuel ratio to stay very close to 14.7:1 .

Acceleration Mode

The ECM looks at rapid changes in throttle position and air flow, and provides extra fuel.

Deceleration Mode

The ECM looks at changes in throttle position and Air Flow to reduce the amount of fuel. When deceleration is very fast, the ECM can cut off fuel completely for short periods.

Battery Voltage Correction Mode

When battery voltage is low, the ECM can compensate for the weak spark delivered by the distributor by:

- Increasing the amount of fuel delivered;
- Increasing the idle rpm; and
- Increasing ignition dwell time.

Fuel Cutoff Mode

No fuel is delivered by the injector when the ignition is "OFF". This prevents dieseling. Also, fuel is not delivered if no reference pulses are seen from the distributor, which means the engine is not running. This prevents flooding.

FUEL CONTROL SYSTEM
Basic System Operation

The fuel system (Figure C2-3) starts with the fuel in the fuel tank. An electric fuel pump, located in the fuel tank with the gage sending unit, pumps fuel to the fuel rail through an in-line fuel filter. The pump is designed to provide fuel at a pressure above the pressure needed by the injectors. A pressure regulator in the fuel rail keeps fuel available to the injectors at a constant pressure, depending on manifold pressure. Unused fuel is returned to the fuel tank by a seperate line. For further information on the fuel tank, in-line filter, and fuel lines, see Section "6C".

The injectors are controlled by the ECM. They deliver fuel in one of several modes, as described above.

In order to properly control the fuel supply, the fuel pump is operated by the ECM through the fuel pump relay and oil pressure switch (see Fuel Pump Electrical Circuit Code 54).

Throttle Body Unit

The throttle body has a throttle valve to control the amount of air delivered to the engine. The TPS and the IAC valve are also mounted on the throttle body.

The throttle body contains vacuum ports located at, above, or below the throttle valve. These ports generate the vacuum signals needed by various components. Engine coolant is directed through the coolant cavity, on the bottom of the throttle body, to warm the throttle valve and prevent icing.

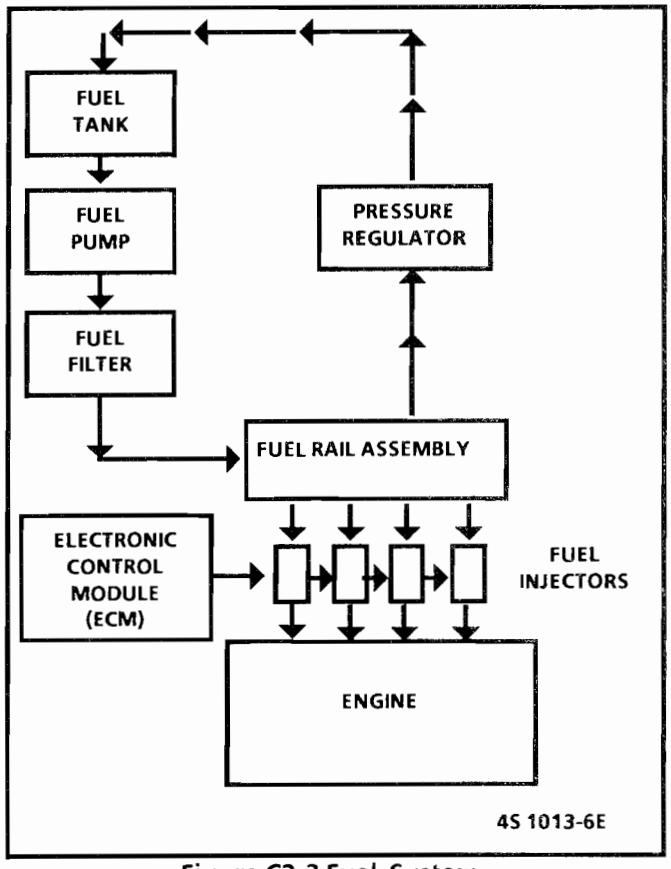


Figure C2-3 Fuel System

Fuel Rail

The fuel rail is mounted to the top of the engine. It distributes fuel to the individual injectors. Fuel is delivered to the input end of the rail by the fuel lines, goes through the rail, then to the pressure regulator. Remaining fuel is then returned to the fuel tank.

Fuel Injectors

The fuel injector is a solenoid operated device controlled by the ECM (see Figure C2-4). The ECM turns on the solenoid, which opens a valve to allow fuel delivery. The fuel, under pressure, is injected in a conical spray pattern at the opening of the intake valve. The fuel, which is not used by the injectors, passes through the pressure regulator before being returned to the fuel tank.

An injector which is stuck partly open will cause loss of pressure after engine shut down, so long crank times would be noticed on some engines. Also, dieseling could occur because some fuel could be delivered to the engine after the ignition is turned "OFF".

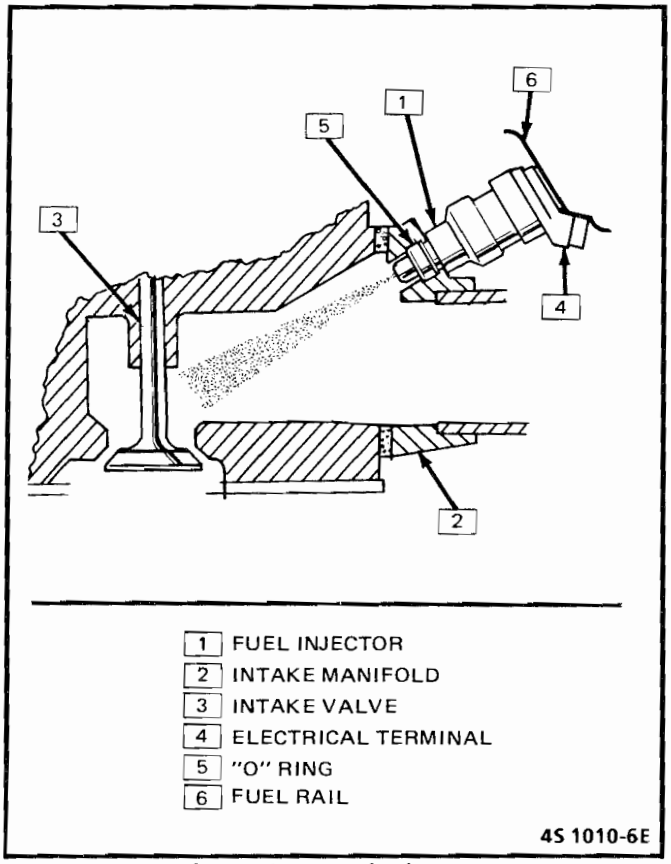


Figure C2-4 Fuel Injector

Pressure Regulator

The pressure regulator is a diaphragm-operated relief valve with injector pressure on one side and manifold pressure on the other. The function of the regulator is to maintain a constant pressure at the injector at all times. The pressure regulator compensates for engine load by increasing fuel pressure when it sees low engine vacuum.

The pressure regulator is mounted on the fuel rail, and is serviced separately.

If the pressure is too low, poor performance could result. If the pressure is too high, excessive odor and a Code 45 may result. Chart A-7 has information on diagnosing fuel pressure conditions.

Idle Air Control (IAC) Valve

The purpose of the Idle Air Control (IAC) valve (shown in Figure C2-5) is to control engine idle speed, while preventing stalls due to changes in engine load.

The IAC valve, mounted in the throttle body, controls bypass air around the throttle valve. By moving a conical valve IN (to decrease air flow) or OUT (to increase air flow), a controlled amount of air can move around the throttle plate. If rpm is too low, more air is bypassed around the throttle valve to increase rpm. If rpm is too high, less air is bypassed around the throttle valve to decrease rpm.

The IAC valve moves in small steps called "counts", which can be monitored a "Scan" tool.

During idle, the proper position of the IAC valve is calculated by the ECM based on battery voltage, coolant temperature, and engine rpm. If the rpm drops below a specified rpm, and the throttle plate is closed, the ECM senses a near stall condition. The ECM will then calculate a new valve position to prevent stalls.

If the IAC valve is disconnected and reconnected with the engine running, the idle rpm may be wrong. In this case, the IAC valve can be reset by starting the engine momentarily and then turning the ignition "OFF".

When servicing the IAC, it should only be disconnected or connected with the ignition "OFF". This will keep from having to reset the IAC.

Different designs are used for the IAC valve. Be sure to use the correct design when replacement is required.

The IAC valve affects only the idle characteristics of the vehicle. If it is open fully, too much air will be allowed into the manifold and idle speed will be high. If it is stuck closed, too little air will be allowed in the manifold, and idle speed will be too low. If it is stuck part way open, the idle may be rough, and will not respond to engine load changes.

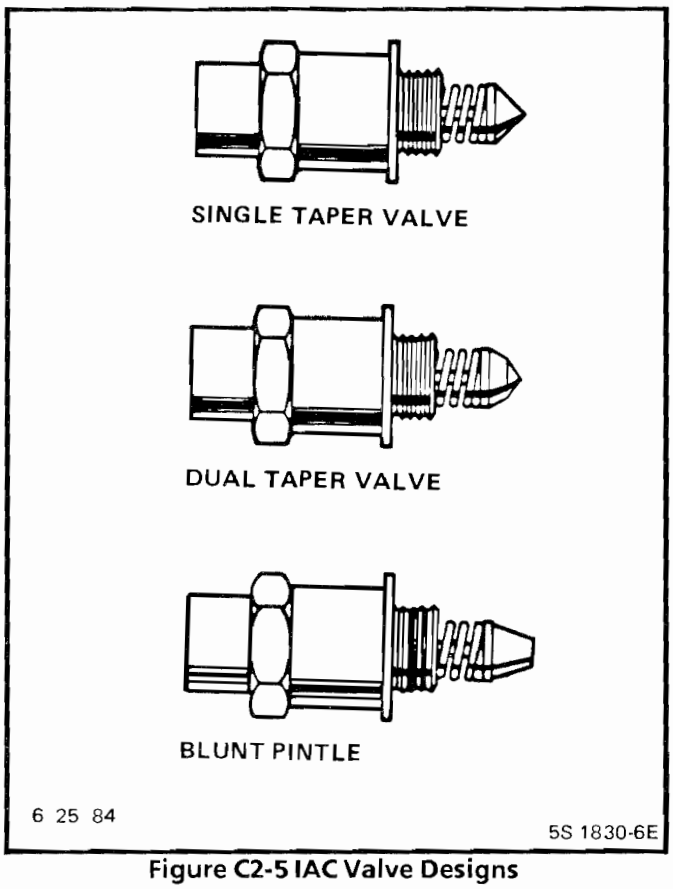


Figure C2-5 IAC Valve Designs

Fuel Pump Electrical Circuit

When the ignition is first turned "ON", without the engine running, the ECM will turn the fuel pump relay "ON" for two seconds. This builds up the fuel pressure quickly. If the engine is not started within two seconds, the ECM will shut the fuel pump "OFF" and wait until the engine starts. As soon as the engine is cranked, the ECM will turn the relay on and run the fuel pump.

As a backup system to the fuel pump relay, the fuel pump can also be turned "ON" by the oil pressure switch. The oil pressure switch is a normally open switch which closes when oil pressure reaches about 28 kPa (4 psi). If the fuel pump relay fails, the oil pressure switch will close and run the fuel pump.

An inoperative fuel pump relay can result in long cranking times, particularly if the engine is cold.

An inoperative fuel pump would cause a no start condition. A fuel pump which does not provide enough pressure can result in poor performance.

DIAGNOSIS

FUEL CONTROL SYSTEM

Some failures of this system will result in an "Engine Cranks But Won't Run". If this condition exists see Chart A-3. This chart will determine if the problem is caused by the Ignition System, ECM, or Fuel Pump Circuit. If it's determined to be a fuel problem Chart A-7 will be used. This includes the injectors, pressure regulator, fuel pump, and fuel pump relay. The fuel system wiring schematic is covered on the facing page of Code Chart 54.

If a malfunction occurs in the fuel control system, it usually results in either a rich or a lean exhaust condition. This condition is sensed by the oxygen sensor and the ECM will change the fuel calculation (injector pulse width) based on the O_2 sensor reading. The change made to the fuel calculation will be indicated by a change in the Block learn values, which can be monitored by a "Scan" tool. The normal block learn values are around 128 and, if the O_2 sensor is sensing a lean condition, the ECM will add fuel and this will result in a block learn value above 128. If the O_2 sensor is sensing a rich exhaust the ECM will reduce fuel to the engine and this will result in Block learn values below 128. Some variations in Block learn values are normal because all engines are not exactly the same. However, if the block learn values are $\pm$ 10 counts from 128 a system problem exists. If the block learn values are greater than 138 see Code 44, for items which can cause a lean system.

If the block learn values are less than 118 see Code 45 for items which can cause the system to run rich. If a driveability symptom exists refer to the particular symptom in Section "B" for additional items to check.

IDLE AIR CONTROL VALVE

A "Scan" tool will read IAC position in steps (counts). "0" steps indicates the ECM is commanding the IAC to be driven all the way in, to a fully seated position, and this is usually caused by a vacuum leak. The higher the number of counts the more air being allowed to pass the IAC valve. Chart C-2C can be used to diagnosis the IAC valve. Also refer to "Rough, Unstable, or Incorrect Idle, Stalling" in Symptoms, Section "B" for other possibilities for the cause of idle problems.

FUEL SYSTEM PRESSURE TEST

A Fuel System Pressure Test is part of several of the Diagnostic Charts and Symptom checks. To perform this test, use the procedure in Chart A-7.

ON-CAR SERVICE

PORT FUEL INJECTION COMPONENTS

CAUTION: **Before servicing an injector, fuel rail, or pressure regulator, it is necessary to relieve the pressure in the fuel system, to minimize the risk of fire and personal injury. (See "Fuel Pressure Relief Procedure" below). To reduce the chance of personal injury, cover the fuel line with a shop cloth to collect the fuel, and then place the cloth in an approved container.**

FUEL PRESSURE RELIEF PROCEDURE

1. Connect fuel gage J 34730-1 or equivalent to fuel pressure valve. Wrap a shop towel around fitting while connecting gage to avoid spillage.
2. Install bleed hose into an approved container and open valve to bleed system pressure.

Plenum

Remove or Disconnect

1. Negative battery cable.
2. Throttle, T.V., and cruise control cable.
3. Cable retaining bracket.
4. Throttle body retaining bolts (4).
5. TPS and IAC valve electrical connectors.
6. Vacuum hoses.
7. Right runners.
8. Plenum retaining bolts.
9. Plenum and gaskets (discard gaskets).

Install or Connect

1. New gaskets.
2. Reverse removal procedures.

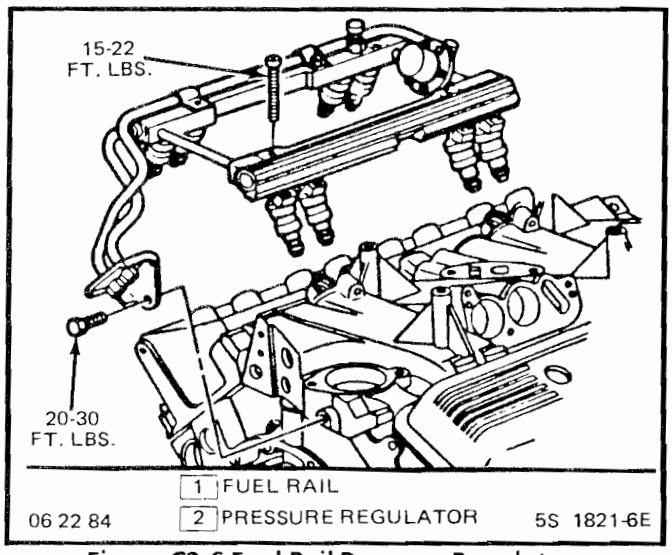


Figure C2-6 Fuel Rail Pressure Regulator

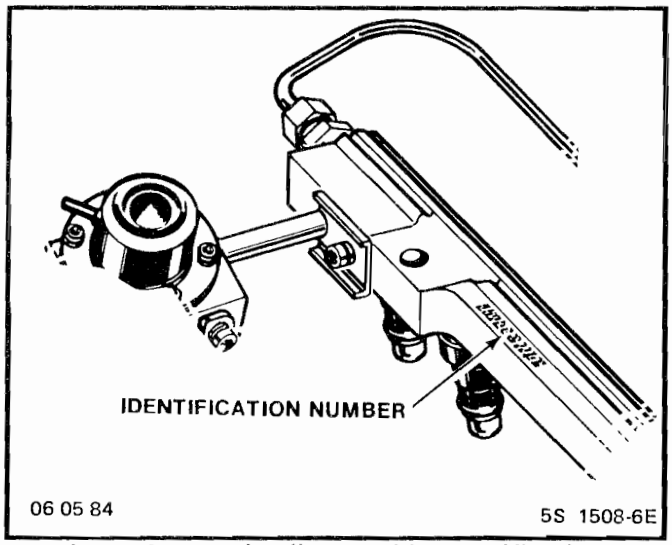


Figure C2-7 Fuel Rail Assembly Identification

FUEL RAIL ASSEMBLY
FUEL RAIL (Figure C2-8)

Remove or Disconnect

1. Negative battery cable.
2. Fuel system pressure following "Fuel Pressure Relief procedure".
3. Plenum. (Refer to Plenum Removal).
4. Cold start valve line.
5. Cold start valve.
6. Fuel lines and injector harness connectors.
7. Loosen rail retaining bolts and raise rail.
8. Runners.
9. Rail and injectors.
10. Injector O-ring seal (86) (Figure C2-8) from each injector spray tip and discard.

Install or Connect

1. New injector O-rings.
2. Coat injector O-rings with engine oil.
3. Reverse removal instructions. Refer to Figure C2-6 for torque specifications.

FUEL RAIL SERVICE

PARTS INFORMATION

PART NAME	PART #
O-ring - Fuel Inlet Line	1
O-ring - Fuel Return Line	2
Assembly - Fuel Pressure Connection	26
Seal - Fuel Pressure Connection	27
Cap - Fuel Pressure Connection	28
Injector - Port	85
Seal - O-Ring - Injector	86
Clip - Injector Retainer	87
Valve - Cold Start	100
Assembly - Tube & Body 101 Seal - O-ring Valve	102
Seal - O-Ring - Body	103
Seal - O-Ring - Tube	104
Assembly - Fuel Rail & Plug (LH)	200
Assembly - Fuel Rail & Plug (RH)	220
Stud Assembly - Rear Bracket Attaching	222
Seal - O-Ring - Fuel Outlet Tube	224
Tube - Front Crossover	230
Seal - O-Ring - Fuel Crossover Tube	232
Retainer - Crossover Tube	234
Screw Assembly - Retainer Attaching	235
Assembly - Pressure Regulator and Base	240
Seal - O-Ring - Connector	252
Connector - Base to Rail	250
Bracket - Pressure Regulator & Base Assembly	255
Screw Assembly - Bracket to rail Attaching	256
Screw Assembly - Bracket to Base Attaching	258
Tube - Rear Crossover	265
Seal - O-Ring - Crossover Tube	267
Retainer - Rear Crossover Tube	270
Screw Assembly - Retainer to LH Rail	271
Screw Assembly - Retainer to Base	273
Screw Assembly - Base to RH Rail	275

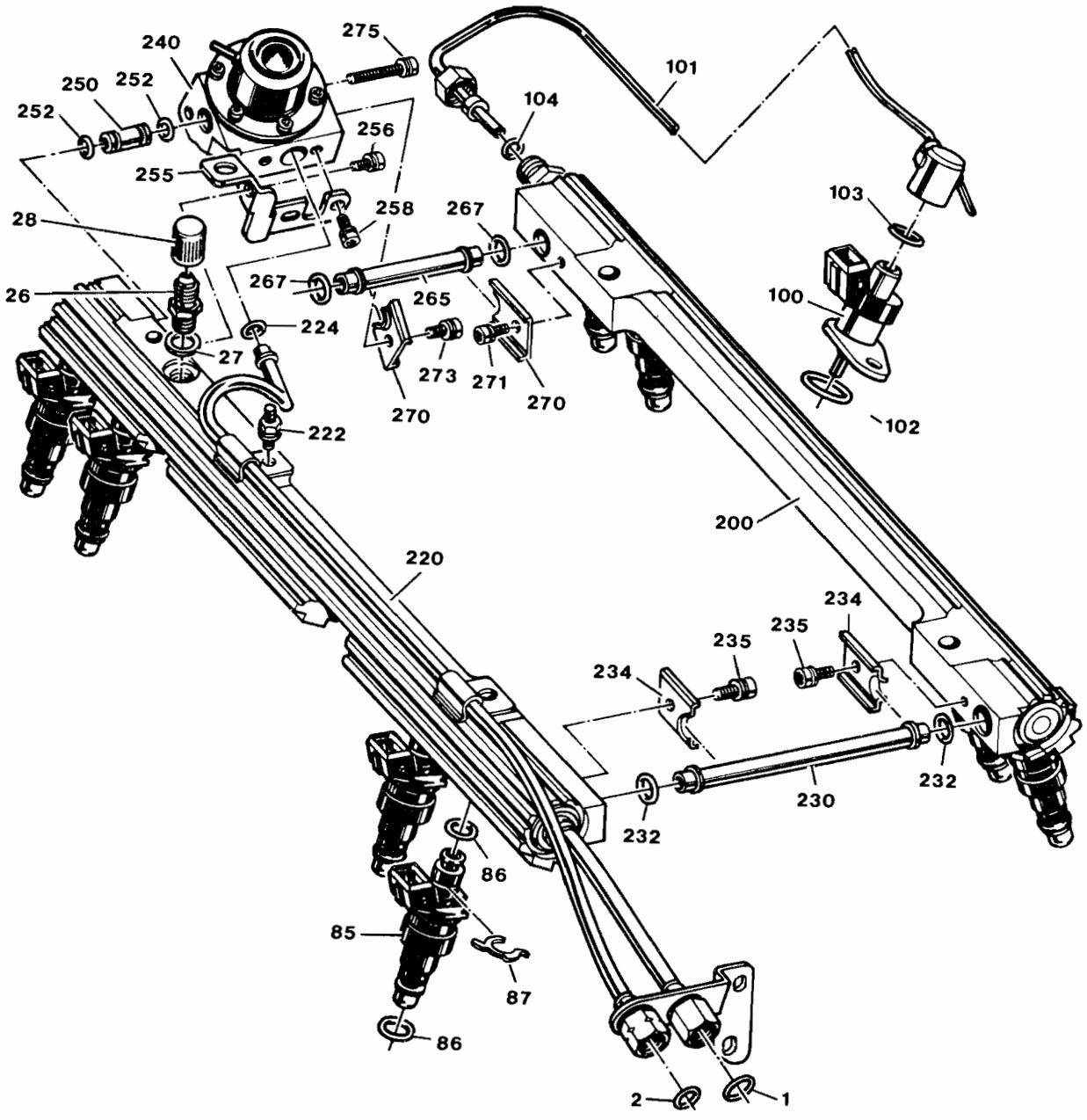


Figure C2-8 Fuel Rail Assembly

FUEL RAIL SERVICE

IDENTIFICATION

An eight digit identification number is stamped on the fuel rail assembly, as shown in Figure C2-7. Refer to this model identification number if servicing or part replacement is required.

Names of component parts will be found on the numbered list that accompanies the dis-assembled view, (Figure C2-8). Numbers used to identify parts there will identify the same parts in other illustrations of this section of the manual.

UNIT SERVICE PROCEDURES

Important

When servicing the fuel rail assembly, precautions must be taken to prevent dirt and other contaminants from entering the fuel passages. It is recommended that fittings be capped, and holes be plugged during servicing.

Important

At any time the fuel system is opened for service, the O-ring seals used with the related component(s) should be replaced.

Cleaning and Inspection

Before disassembly, the fuel rail assembly may be cleaned with a spray type engine cleaner, such as AC Delco X-30A or equivalent, following package instructions. The fuel rail should not be immersed in liquid solvent.

COLD START TUBE AND VALVE ASSEMBLY (Figure C2-9)

Remove or Disconnect

1. Negative battery Cable.
2. Relieve fuel system pressure, following "Fuel Pressure Relief Procedure".
3. Plenum, per previous instructions.
4. Brake booster line.
5. Tube and body assembly (101) at fitting on fuel rail.
6. Electrical connector from cold start valve (100).
7. PVC hose.
8. Cold start valve retaining bolt.
9. Cold start valve assembly from fuel rail and intake manifold.

Disassemble

1. Raise tab on tube and body assembly (101) to clear electrical connector and unscrew cold start valve (100).
2. O-ring seals (102, 103, and 104) from tube and body assembly (101), cold start vlave (100), and fuel rail fitting. Discard seals.

Assemble

1. Lubricate new O-ring seals (102, 103, and 104) with engine oil and install at following locations:
   - O-ring seal (102) goes on end of cold start valve (100).
   - O-ring seal (103) goes inside body of tube and body asembly (101).
   - O-ring seal (104) goes up against collar of tube and body assembly.
2. Cold start valve (100) onto tube and body assembly.
   - Screw in until valve bottoms, then back off until hole in mounting lug on valve will be aligned properly with hole in fuel rail when mounted.
   - Bend tang over cold start valve to lock it in position.

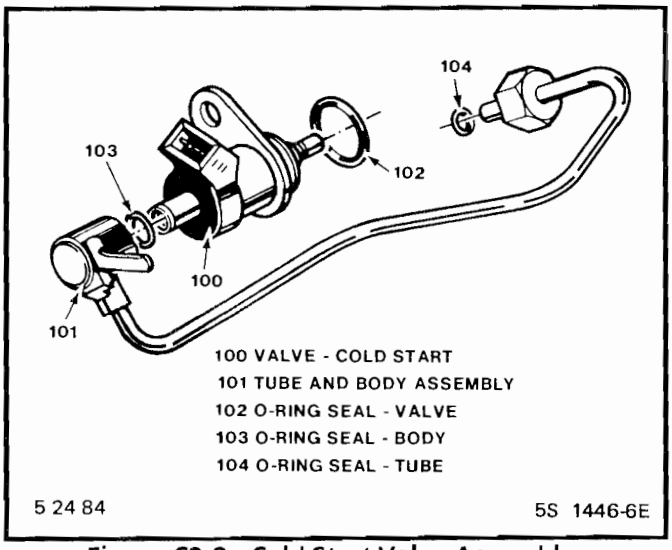


Figure C2-9 Cold Start Valve Assembly

Clean

- Areas around valve and connection with AC Delco X-30A or equivqlent.

Install or Connect

1. Cold start (100) valve in intake manifold.
2. Cold start valve retaining bolt.

Tighten

- Retaining bolt to 27 N•m (20 ft. lbs.).

3. PVC hose.
4. Tube and body assembly (101) at fitting on fuel rail.

Tighten

- Nut on fitting to 27 N•m (20 ft. lbs.).

6. Brake booster line.
6. Electrical connector on cold start valve (100).
7. Negative battery cable.

Inspect

- Energize fuel pump and inspect for leaks.

8. Intake manifold plenum, per previous instructions.

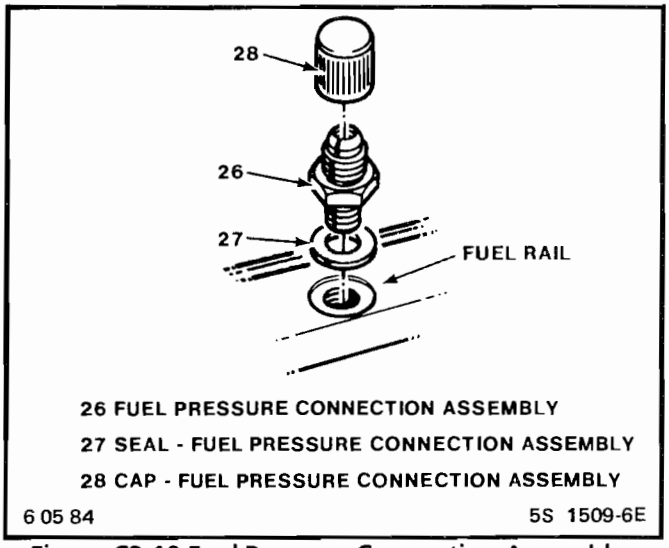


Figure C2-10 Fuel Pressure Connection Assembly

FUEL PRESSURE CONNECTION ASSEMBLY (Figure C2-10)

Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel system pressure following "Fuel Pressure Relief" procedure.

Clean

- Area around valve and connection with AC Delco X-30A or equivalent.

3. Fuel pressure connection assembly (26) and seal (27). Discard seal

Install or Connect

1. New seal (27) on fuel pressure connection assembly (26).
2. Fuel pressure connection assembly (26)in fuel rail.

Tighten

- Fuel pressure connection assembly to 10.0 N•m (88.0 in. lbs.)

3. Negative battery cable.

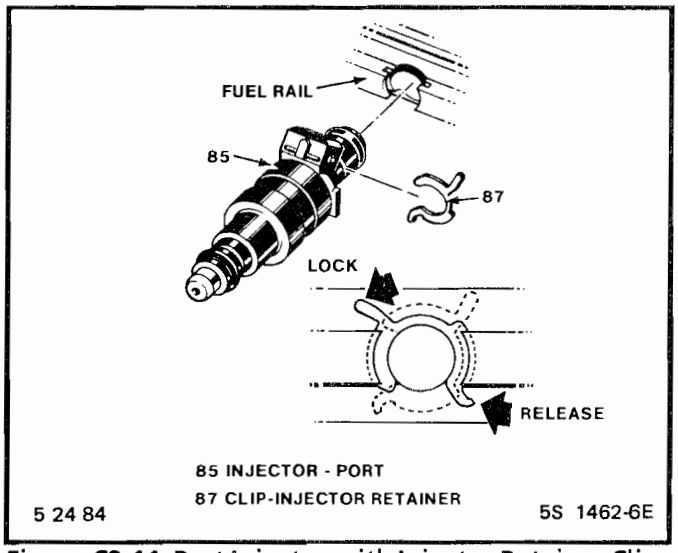


Figure C2-11 Port Injector with Injector Retainer Clip

Inspect

- Energize fuel pump and check for leaks.

FUEL INJECTORS (With Fuel Rail Removed)

Each port injector is located and held in position by a retainer clip that must be rotated to release and/or lock the injector in place, as shown in Figure C2-11.

Remove or Disconnect

1. Rotate injector retaining clip(s) (87) to unlocked position.
2. Injectors (85).

Disassemble

1. Injector O-ring seals (86) from both ends of injectors (85) and discard.

Assemble

- New O-ring seals (86) and install on injectors (85).

Install or Connect

1. Injectors to fuel rail and pressure regulator assembly (11).
2. Rotate injector retainer clips (87) to locking position (Figure C2-11).

PRESSURE REGULATOR (With Fuel Rail Removed)

Important

The pressure regulator is factory adjusted and is not serviceable. Do not attempt to remove regulator cover.

Remove or Disconnect

1. Front crossover tube retainer attaching screw assembly (235) and crossover tube retainer (234) on right hand rail side.
2. Retainer to base screw assembly (273) and rear crossover tube retainer (270) at pressure regulator and base assembly (240).
3. Separate left hand fuel rail and plug assembly (200) from right hand fuel rail and plug assembly (220).
4. Bracket-to-rail attaching screw assembly (256), two bracket-to-base attaching screw assemblies (258) and pressure regulator and base assembly bracket (255).
5. Screw assembly (235), which attaches fuel outlet tube to right hand rail (220).
6. Base to right hand rail screw assembly (275).
7. Pressure regulator and base assembly (240) from right hand rail assembly (220).
8. Rotate regulator and base assembly to remove from fuel outlet tube.
9. Base to rail connector (250).
10. O-ring seals and discard:
    - Connector (252).
    - Fuel outlet tube (224).
    - Rear crossover tube (267).
    - Front crossover tube (232).

Important

When removing O-ring seals, note locations and sizes, to assure correct replacement and reassembly.

Inspect

- O-rings and sealing surfaces, for damage that could prevent proper sealing.
  - Replace any damaged O-ring seals.

Install or Connect

1. Lubricate with engine oil, and install O-ring seals:
    - Connector (252).
    - Fuel outlet tube (224).
    - Rear crossover tube (267).
    - Front crossover tube (232).
2. Base-to-rail connector (250) in pressure regulator and base assembly (240).
3. Regulator and base assembly on fuel outlet tube.
4. Rotate the regulator and base assembly to install base to rail connector (250) into right hand rail assembly (220).
5. Base to right hand rail screw assembly (275).
6. Pressure regulator and base assembly bracket (255), two brackets to base attaching screw assembly (258) and bracket to rail attaching screw assembly (256).
7. Rear bracket attaching screw assembly (235).
8. Left hand rail and plug assembly (200), with front and rear crossover tubes (230) and 265), to right hand rail and tube assembly (220).
9. Rear crossover tube retainer (270) and retainer to base screw assembly (273).
10. Front crossover tube retainer (234) and retainer attaching screw assembly (235).

Tighten

- Above mentioned seven assemblies to 5 N•m (44 in. lbs.).

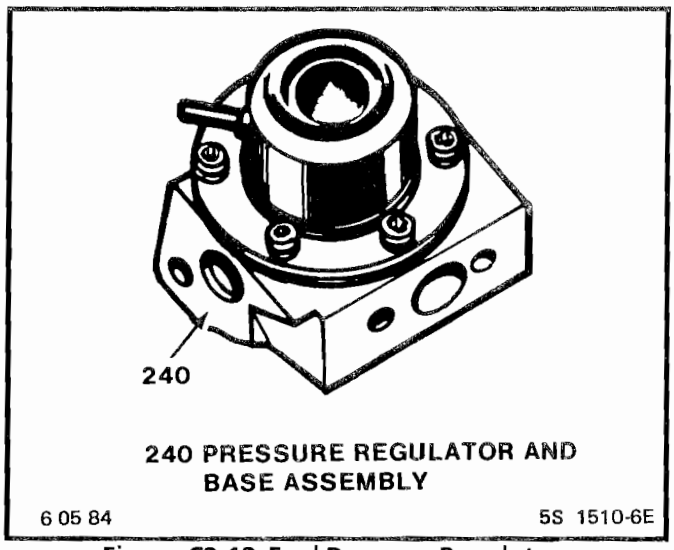


Figure C2-12 Fuel Pressure Regulator

COLD START FUEL INJECTION SWITCH

Remove or Disconnect

1. Air inlet duct.
2. Diverter valve bracket.
3. Electrical connector.
4. Switch.

Install or Connect

1. Coat threads with pipe sealant.
2. Reverse removal procedure to reinstall.

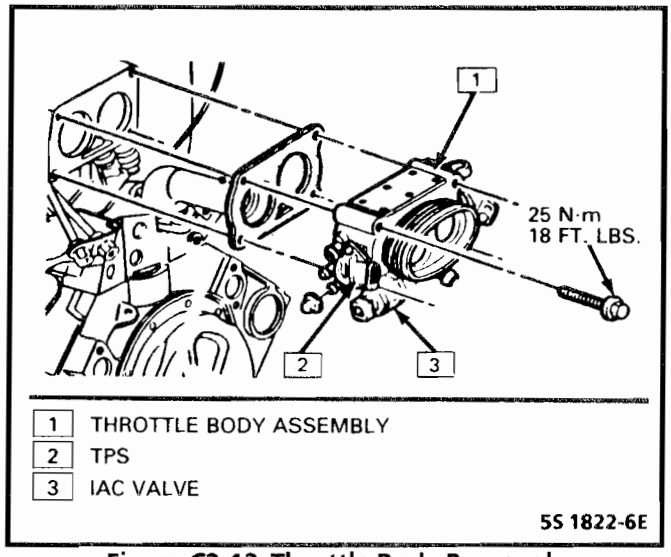


Figure C2-13 Throttle Body Removal

THROTTLE BODY

Remove or Disconnect

1. Air inlet duct.
2. IAC and TPS connectors.
3. Vacuum lines.
4. Coolant hoses (2).
5. Throttle, TV, and cruise control cables.
6. Throttle body retaining bolts.

Install or Connect

1. Reverse procedure to reinstall.
2. Refill radiator with lost coolant. Refer to Figure C2-13 for torque specifications.

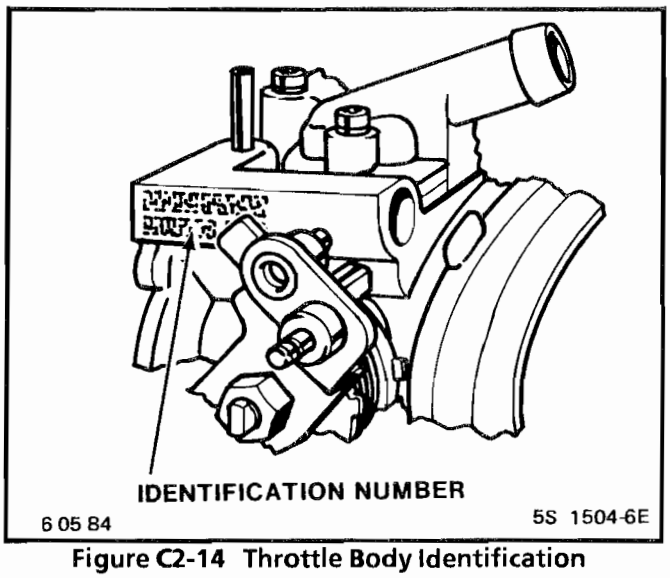


Figure C2-14 Throttle Body Identification

THROTTLE BODY SERVICE IDENTIFICATION

An eight digit identification number is stamped on the throttle body casting, next to the coolant cover, as shown in Figure C2-14. Refer to this model identification number if servicing or part replacement is required.

Names of component parts will be found on the numbered list that accompanies the exploded view (Figure C2-17). Numbers used to identify parts in the exploded views also are used to identify the same parts in other illustrations of this manual.

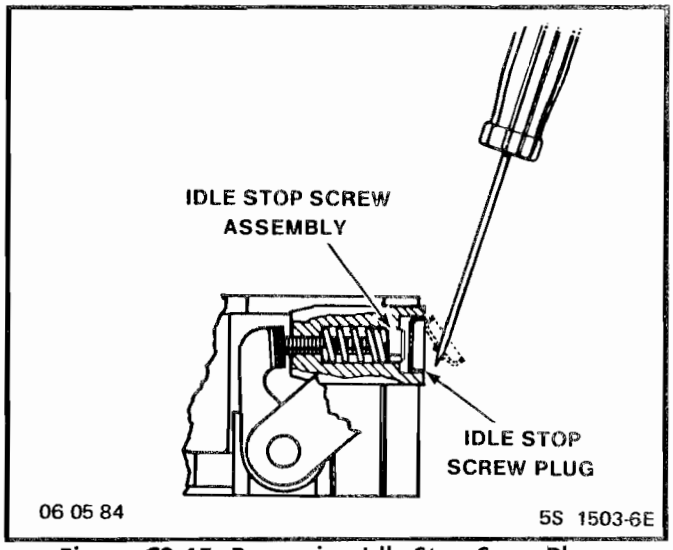


Figure C2-15 Removing Idle Stop Srew Plug

MINIMUM IDLE SPEED ADJUSTMENT

The Idle Stop Screw (16), used to regulate minimum idle speed of the engine, is adjusted at the factory, then is covered with a plug (15) to discourage unnecessary readjustment. However, if it is necessary to gain access to the Idle Stop Screw assembly, proceed as shown in Figure C2-15.

Before checking minimum idle speed, be sure ignition timing is correct and, before making any idle speed adjustments, be sure throttle body is clean around the throttle plates.

Adjust

1. Pierce the idle stop screw plug (15) with an awl, and apply leverage to remove it.
2. Adjust idle stop screw assembly (16) as required.
3. With IAC motor connected, ground diagnostic terminal .

4. Turn "ON" ignition, do not start engine. Wait at least 30 seconds.
5. With ignition "ON", disconnect IAC electrical connector.

Important

Disconnect the distributor set-timing connector.

6. Start engine and allow to go "Closed Loop".
7. Remove ground from diagnostic terminal.
8. Adjust idle stop screw to 450 rpm in neutral for manual or automatic transmission vehicles.
9. Turn ignition "OFF" and reconnect connector at IAC motor.
10. Adjust TPS, if necessary:
    - With ignition "ON", use a "Scan" tool and adjust TPS to obtain .54 volt $\pm$ .08 volt.
    - Tighten screws, then recheck reading to insure adjustment has not changed.
11. Start engine and inspect for proper idle operation.

UNIT REPAIR PROCEDURES

TPS Adjustment

Refer to Section C-1 for TPS adjustment.

The unit repair procedures cover component replacement with the unit on the vehicle. However, throttle body replacement requires that the complete unit be removed from the engine. If removed, it may be placed on a holding fixture, such as J-9789-118, BT-3553, or equivalent, to prevent damage to the throttle valve.

Cleaning and Inspection

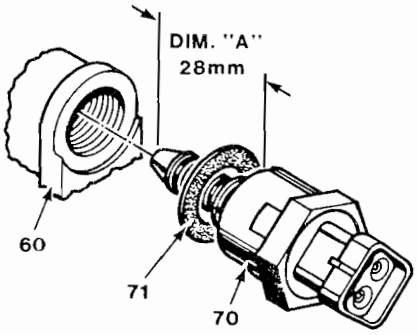
Throttle body parts, except as noted below, may be cleaned in a cold immersion-type cleaner such as AC Delco X-55 or equivalent.

NOTICE: The Throttle Position Sensor (TPS), Idle Air Control (IAC) valve, throttle body with cover and seals or gaskets in place, should NOT be soaked in liquid solvent or cleaner, as they may be damaged. If TPS or IAC valve is still mounted in the throttle body, do not immerse throttle body.

1. Clean all metal parts throughly and blow dry with shop air. Be sure all air passages are free of burrs and dirt.
2. Inspect mating casting surfaces for damage that could affect gasket sealing.

PARTS INFORMATION

PART NAME	PART #
Gasket - Flange	1
Throttle Body Assembly	10
Plug - Idle Stop Screw	15
Screw Assembly - Idle Stop	16
Spring - Idle Stop Screw	17
Sensor - Throttle Position (TPS)	20
Screw Assembly - TPS Attaching	21
Retainer - TPS Attaching Screw	22
Cover - Clean Air	41
Screw Assembly - Clean Air Cover Attaching	42
Gasket - Clean Air Cover	43
IACV/Coolant Cover Assembly	61
Screw Assembly - IACV Cover Assembly to Throttle Body	62
Gasket - IACV/Coolant Cover to Throttle Body	63
Valve Assembly - Idle Air Control (IAC)	70
Gasket - IAC Valve Assembly	71



60 IDLE AIR/VACUUM SIGNAL HOUSING
70 IDLE AIR CONTROL VALVE (IAC)
71 IAC GASKET

5 24 84 5S 1455-6E

Figure C2-16 Idle Air Control Valve Assembly

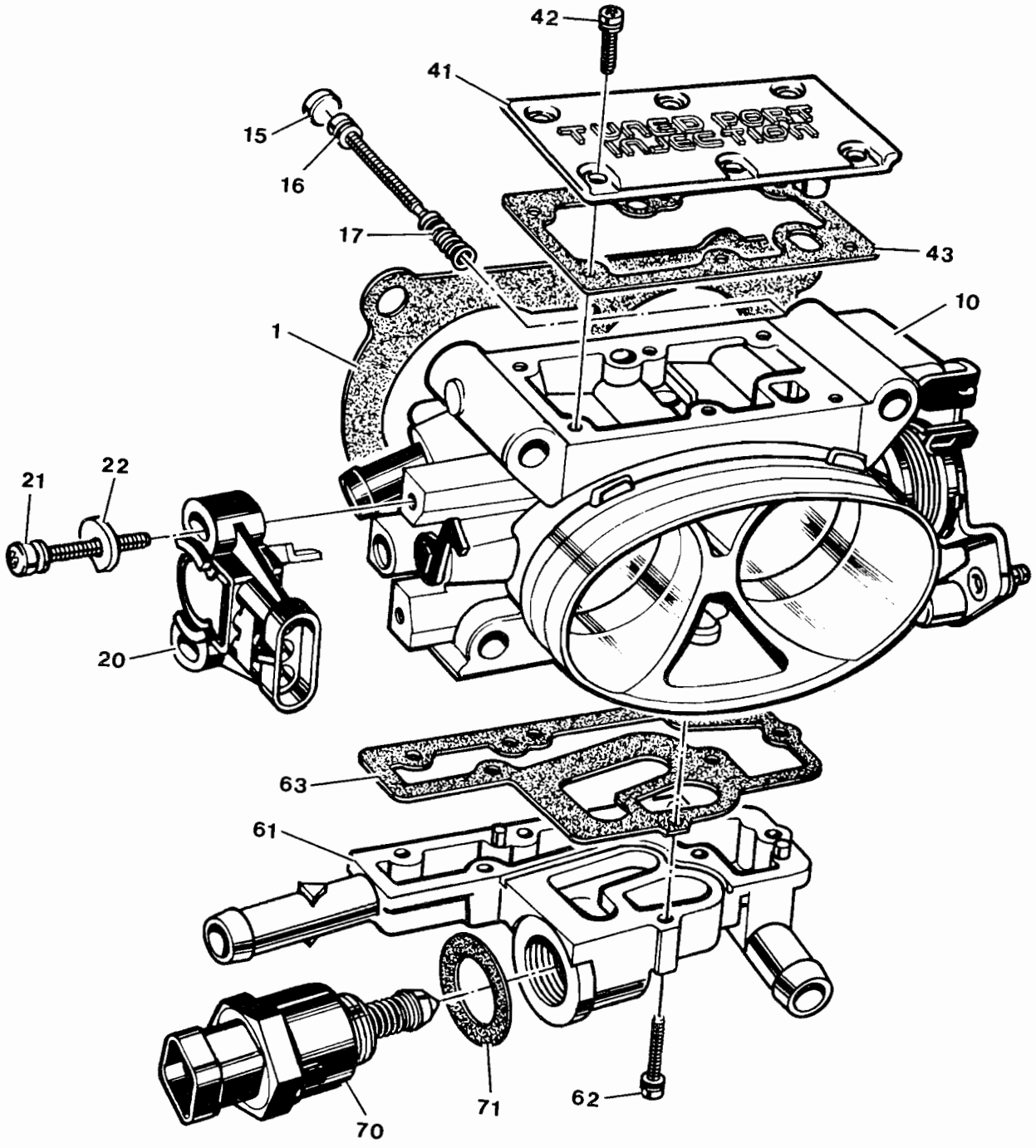


Figure C2-17 Throttle Body

IDLE AIR CONTROL VALVE ASSEMBLY AND GASKET

Remove or Disconnect

1. Electrical connector at idle air control valve assembly (70).
2. IAC valve assembly from IACV/coolant cover assembly.
3. IAC valve assembly gasket (71) and discard.

NOTICE: Before installing new idle air control valve assembly, the position of its pintle MUST be checked. If pintle is extended too far, damage to the assembly may occur.

Measure

- Distance from gasket mounting surface of IAC valve assembly (70) to tip of pintle, (Dimension "A" in Figure C2-16).

Adjust

If distance is greater that 28 mm (1 1/8 in.), reduce it as follows:

a. If IAC valve assembly has a "collar" around electrical connector end, use firm hand pressure on pintle to retract it. (A slight side-to-side motion may help.)
b. If IAC valve assembly has no "collar", compress pintle-retaining spring toward body of IAC valve and try to turn pintle clockwise.
   - If pintle will turn, continue turning until 28mm (1 1/8 in.) is reached. Return spring to original position, with straight part of spring end lined up with flat surface under pintle head.
   - If pintle will not turn, use firm hand pressure to retract it.

Install or Connect

1. New IAC valve assembly gasket (71) on IAC valve assembly (70).
2. IAC valve assembly in IACV/coolant cover assembly (61).

Tighten

- IAC valve assembly to 18N•m (13 ft. lbs.), with wrench on hex surface only.

3. Electrical connector at IAC valve assembly (70).

Important

No physical adjustment is made to the IAC assembly after installation. IAC valve resetting occurs after reinstallation on the vehicle, and is reset after the engine is started and then the ignition turned "OFF".

CLEAN AIR COVER AND GASKET

Remove or Disconnect

1. Clean air cover attaching screw assemblies (42).
2. Clean air cover (41).
3. Clean air cover gasket (43).

Clean

- Cover mounting surface to ensure a good seal.

Install and Connect

1. New clean air cover gasket (43) on throttle body assembly (10).
2. Clean air cover (41).
3. Clean air cover attaching screw assemblies (42).

IDLE AIR CONTROL/COOLANT COVER ASSEMBLY (Figure C2-18) (With Throttle Body Removed From Engine)

Remove or Disconnect

1. Idle air control (IAC) valve assembly (70) from IACV/coolant cover assembly. (See "Idle Air Control Valve and Gasket" instructions.)
2. IACV cover assembly to throttle body screw assemblies (62).
3. Cover assembly (61).
4. Cover assembly to throttle body gasket (63) and discard.

Install or Connect

Clean

- Throttle body gasket mounting surface to ensure a good seal.
- Sealing surface for damage that could prevent sealing properly or cause coolant leak.

Install and Connect

1. New IACV/coolant cover assembly to throttle body gasket (63).
2. IACV/coolant cover assembly (61).
3. IACV cover assembly to throttle body screw assemblies (62).

Tighten

- Screw assemblies to 3.0 N•m (27.0 in. lbs.).

4. IAC valve assembly (70). (See "Idle Air Control Valve and Gasket" instructions.)

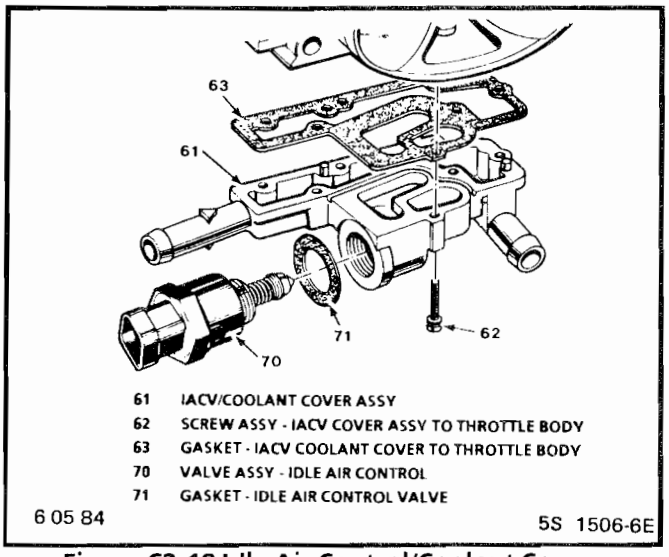


Figure C2-18 Idle Air Control/Coolant Cover Assembly

NOTICE: Before installing the IAC valve assembly, the position of its pintle MUST be checked. If pintle is extended too far, damage to the assembly may occur. (See "Idle Air Control Valve and Gasket" instructions.)

FUEL PUMP RELAY

The fuel pump relay is mounted in the engine compartment (see Figure C2-19). Other than checking for loose connectors, the only service possible is replacement.

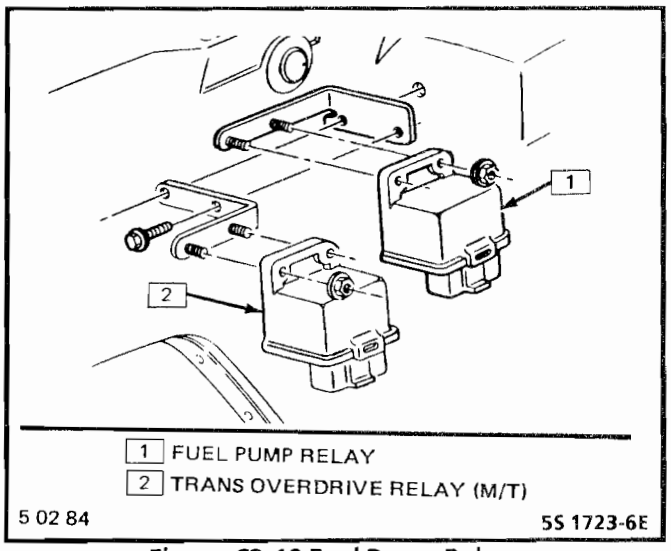


Figure C2-19 Fuel Pump Relay

OIL PRESSURE SWITCH

The oil pressure switch is mounted as shown in Figures C2-20.

Remove or Disconnect

1. Electrical Connector.
2. Oil Pressure Switch.

Install or Connect

1. Make sure fittings (41) are properly aligned to allow switch installation.
2. Oil Pressure Switch.
3. Electrical Connector.

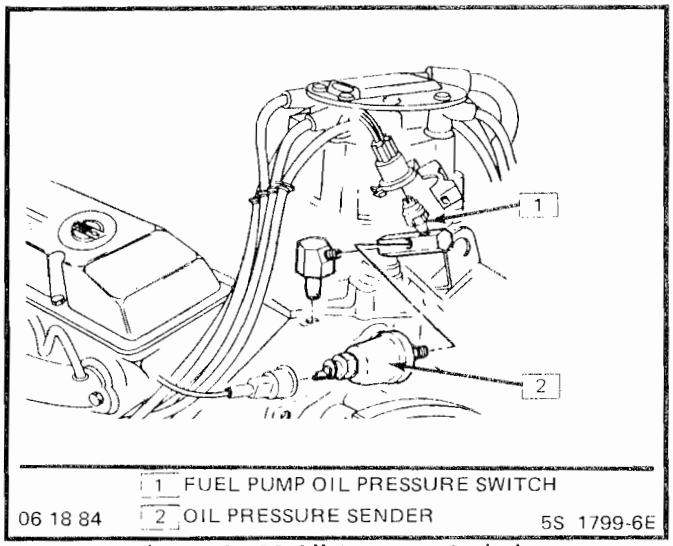


Figure C2-20 Oil Pressure Switch

PARTS INFORMATION

PART NAME	GROUP
Injector, fuel	3.300
Pump, Fuel (In-Tank)	3.900
Relay, Fuel Pump	3.900
Switch, Oil Pressure	1.800
Valve Asm, Idle Air Control: Part Of Control Kit, Idle Air Valve	3.820
Regulator, Fuel Pressure	3.164
Rail, Fuel Feed	3.330

CHART C-2A

INJECTOR BALANCE TEST

The injector balance tester is a tool used to turn the injector on for a precise amount of time, thus spraying a measured amount of fuel into the manifold. This causes a drop in fuel rail pressure that we can record and compare between each injector. All injectors should have the same amount of pressure drop (± 10 kpa). Any injector with a pressure drop that is 10 kpa (or more) greater or less than the average drop of the other injectors should be considered faulty and replaced.

STEP 1

Engine "cool down" period (10 minutes) is necessary to avoid irregular readings due to "Hot Soak" fuel boiling. With ignition "OFF" connect fuel gauge J347301 or equivalent to fuel pressure tap. Wrap a shop towel around fitting while connecting gage to avoid fuel spillage.

Disconnect harness connectors at all injectors, and connect injector tester J-34730-3, or equivalent, to one injector. On Turbo equipped engines, use adaptor harness furnished with injector tester to energize injectors that are not accessible. Follow manufacturers instructions for use of adaptor harness. Ignition must be "OFF" at least 10 seconds to complete ECM shutdown cycle. Fuel pump should run about 2 seconds after ignition is turned "ON". At this point, insert clear tubing attached to vent valve into a suitable container and bleed air from gauge and hose to insure accurate gauge operation. Repeat this step until all air is bled from gauge.

STEP 2

Turn ignition "OFF" for 10 seconds and then "ON" again to get fuel pressure to its maximum. Record this initial pressure reading. Energize tester one time and note pressure drop at its lowest point (Disregard any slight pressure increase after drop hits low point.). By subtracting this second pressure reading from the initial pressure, we have the actual amount of injector pressure drop.

STEP 3

Repeat step 2 on each injector and compare the amount of drop. Usually, good injectors will have virtually the same drop. Retest any injector that has a pressure difference of 10kPa, either more or less than the average of the other injectors on the engine. Replace any injector that also fails the retest. If the pressure drop of all injectors is within 10kPa of this average, the injectors appear to be flowing properly. Reconnect them and review Symptoms, Section B.

NOTE: ***The entire test should not be repeated more than once without running the engine to prevent flooding. (This includes any retest on faulty injectors).***

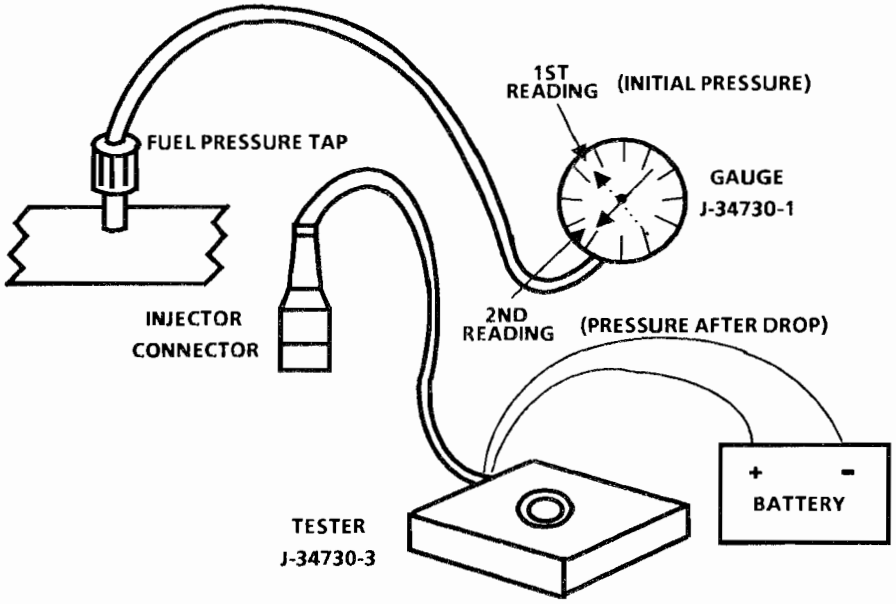
CHART C-2A
INJECTOR BALANCE TEST 5.7L "Y" SERIES (PORT)

NOTE: If injectors are suspected of being dirty, they should be cleaned using an approved tool and procedure prior to performing this test. The fuel pressure test in Section A, Chart A-7, should be completed prior to this test.

Step 1. If engine is at operating temperature, allow a 10 minute "cool down" period then connect fuel pressure gauge and injector tester.
1. Ignition "OFF".
2. Connect fuel pressure gauge and injector tester.
3. Ignition "ON".
4. Bleed off air in gauge. Repeat until all air is bled from gauge.

Step 2. Run test:
1. Ignition "OFF" for 10 seconds.
2. Ignition "ON". Record gauge pressure. (Pressure must hold steady, if not see the Fuel System diagnosis, Chart A-7, in Section A) .
3. Turn injector on, by depressing button on injector tester, and note pressure at the instant the gauge needle stops.

Step 3.
1. Repeat step 2 on all injectors and record pressure drop on each. Retest injectors that appear faulty (Any injectors that have a 10 kPa difference, either more or less, in pressure from the average). If no problem is found, review Symptoms Section B.



— EXAMPLE —

CYLINDER	1	2	3	4	5	6
1ST READING	225	225	225	225	225	225
2ND READING	100	100	100	90	100	115
AMOUNT OF DROP	125	125	125	135	125	110
	OK	OK	OK	FAULTY, RICH (TOO MUCH) (FUEL DROP)	OK	FAULTY, LEAN (TOO LITTLE) (FUEL DROP)

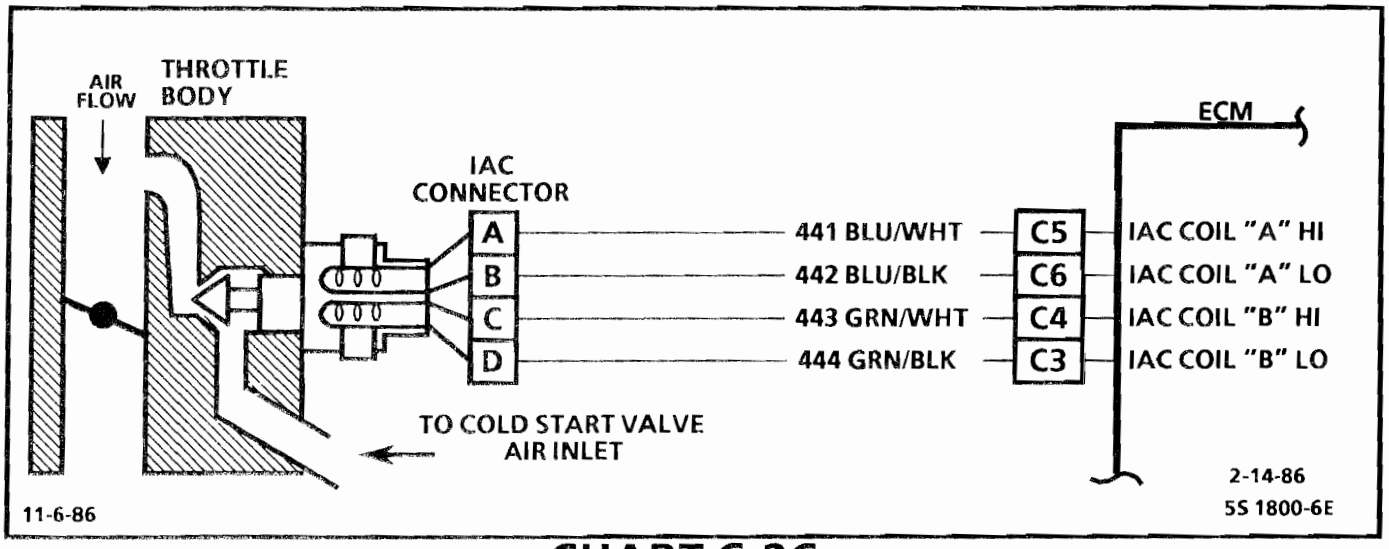


CHART C-2C

IDLE AIR CONTROL (IAC) SYSTEM CHECK 5.7L "Y" SERIES (PORT)

Circuit Description:

The ECM will control engine idle speed by moving the IAC valve to control air flow around the throttle plates. It does this by sending voltage pulses to the proper motor winding for each IAC motor. This will cause the motor shaft and valve to move "IN" or "OUT" of the motor a given distance for each pulse received. ECM pulses are referred to as "counts".

- To increase idle speed - ECM will send enough counts to retract the IAC valve and allow more air to flow through the idle air passage and bypass the throttle plates until idle speed reaches the proper rpm. This will increase the ECM counts.
- To decrease idle speed - ECM will send enough counts to extend the IAC valve and reduce air flow through the idle passage around the throttle plates. This will reduce the ECM counts.

Each time the engine is started and then the ignition is turned "OFF", the ECM will reset the IAC valve. This is done by sending enough counts to seat the valve. The fully seated valve is the ECM reference Zero. A given number of counts are then issued to open the valve, and normal ECM control of IAC will begin from this point. The number of counts are then calculated by the ECM. This is how the ECM knows what the motor position is for a given idle speed.

The ECM uses the following information to control idle speed.

- Battery voltage
- Coolant Temperature
- Throttle Position Sensor
- Engine Speed
- A/C clutch signal
- P/N switch

Don't apply battery voltage across the IAC motor terminals. It will permanently damage the IAC motor windings.

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. Continue with test, even if engine will not idle. If idle is too low, "Scan" will display 80 or more counts, or steps. If idle is high, it will display "0" counts.
   Occasionally an erratic or unstable idle may occur. Engine speed may vary 200 rpm or more up and down. Disconnect IAC. If the condition is unchanged, the IAC is not at fault. There is a system problem. Proceed to diagnostic aids below.
2. When the engine was stopped, the IAC Valve retracted (more air) to a fixed "Park" position for increased air flow and idle speed during the next engine start. A "Scan" will display 140 or more counts.
3. Be sure to disconnect the IAC valve prior to this test. The test light will confirm the ECM signals by a steady or flashing light on all circuits.
4. There is a remote possibility that one of the CKTs is shorted to voltage which would have been indicated by a steady light. Disconnect ECM and turn the ignition "ON" and probe terminals to check for this condition.

Diagnostic Aids:

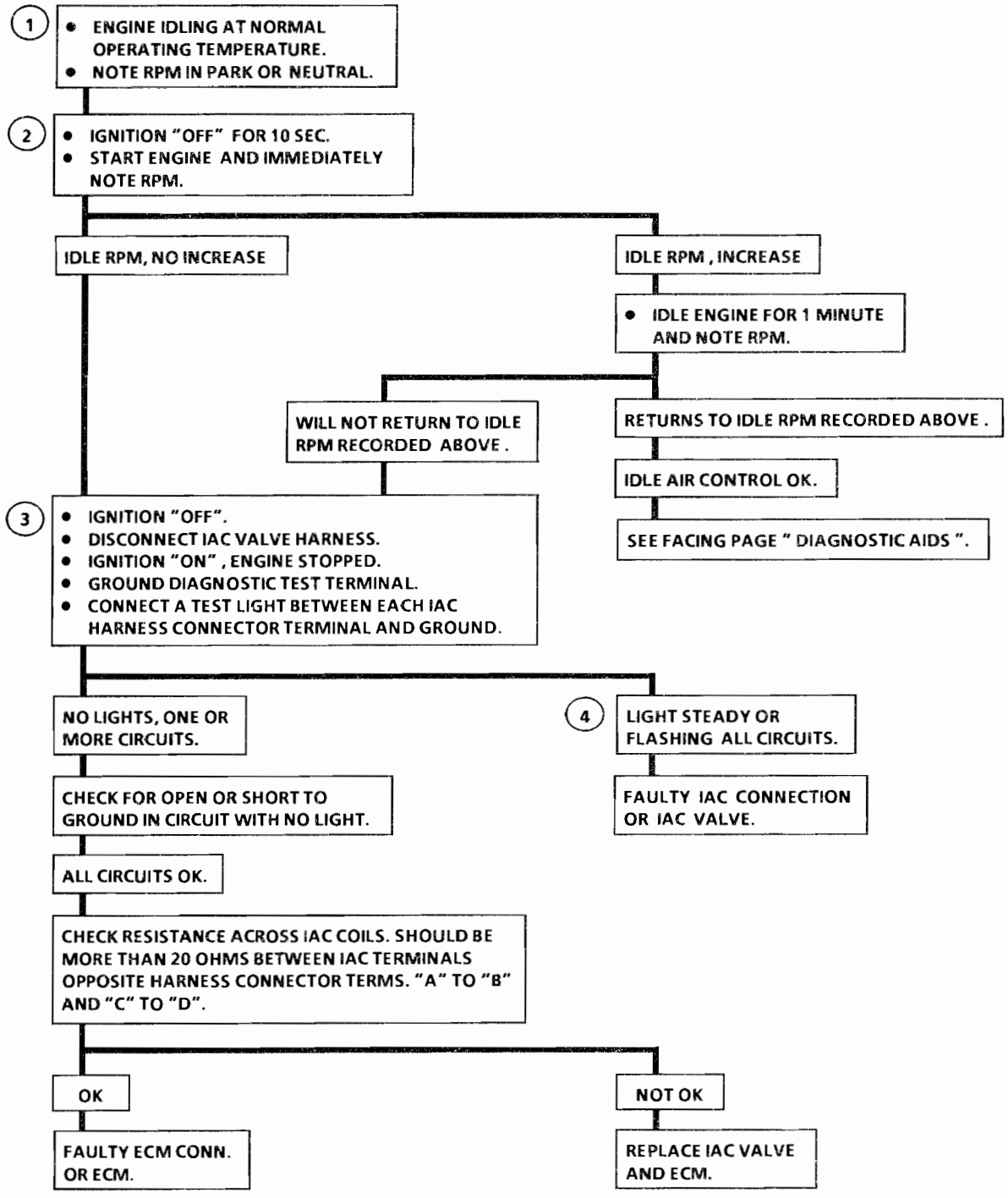
Engine idle speed can be adversely affected by the following:

- Park/Neutral Switch - If ECM thinks the car is always in neutral, then idle will not be controlled to the specified rpm when in drive range.
- Leaking injector(s) will cause fuel imbalance and poor idle quality due to excess fuel. See Chart A-7.
- Vacuum or crankcase leaks can affect idle.
- When the throttle shaft or throttle position sensor is binding or sticking in an open throttle position, the ECM does not know if the vehicle has stopped and does not control idle.
- Check Air management system for intermittent air to ports while in closed loop.
- In addition to electrical control of EGR, be sure to examine the EGR valve for proper seating.
- Faulty battery cables can result in voltage variations. The ECM will try to compensate, which results in erratic idle speeds.
- The ECM will compensate for A/C compressor clutch loads. Loss of this signal would be most apparent in neutral.
- Contaminated fuel can adversely affect idle.
- Perform injector balance test CHART C-2A.

If all OK, refer to Rough, Unstable, Incorrect Idle or Stalling Symptoms in Section "B".

CHART C-2C

IDLE AIR CONTROL (IAC)SYSTEM CHECK 5.7L "Y" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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SECTION C3
EVAPORATIVE EMISSION CONTROL SYSTEM (EECS)
CONTENTS

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PURGE VALVE OPERATION C3-1
FUEL TANK PRESSURE CONTROL VALVE .. C3-1
RESULTS OF INCORRECT OPERATION C3-2
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FUNCTIONAL TESTS C3-2
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GENERAL DESCRIPTION

PURPOSE

The basic Evaporative Emission Control System (EECS) used on all vehicles is the charcoal canister storage method. This method transfers fuel vapor from the fuel tank to an activated carbon (charcoal) storage device (canister) to hold the vapors when the vehicle is not operating. When the engine is running, the fuel vapor is purged from the carbon element by intake air flow and consumed in the normal combustion process.

PURGE VALVE OPERATION

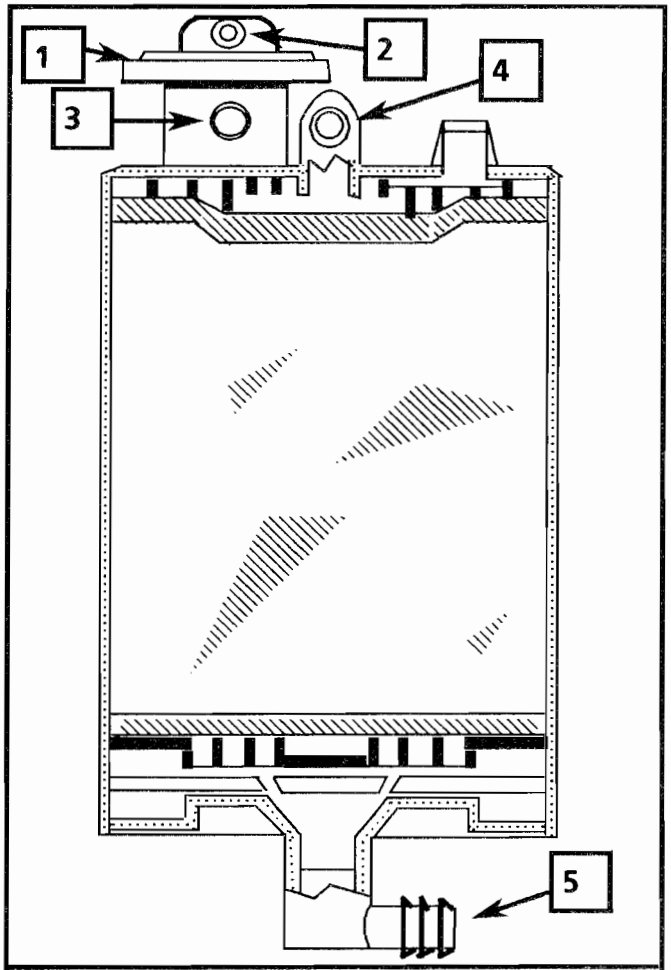
The purge valve is an integral part of the canister (Figure C3-1). When the engine is running, vacuum is supplied to the top of the purge valve (Control Vacuum Signal) which lifts the valve diaphragm and opens the valve. The lower tube on the purge valve is connected to manifold vacuum on the throttle body.

This system has a remote mounted purge control solenoid. The ECM operates this solenoid to control vacuum to the canister purge valve. Under cold engine or idle conditions, the solenoid is turned on by the ECM, which blocks vacuum to the canister control valve and prevents purge.

The ECM turns off the solenoid valve and allows purge when:

- Engine is warm
- After the engine has been running a specified period of time.
- Above a specified road speed
- Above a specified throttle opening.

The control valve only opens when sufficient vacuum is applied, thus preventing purge under conditions of low ported vacuum.

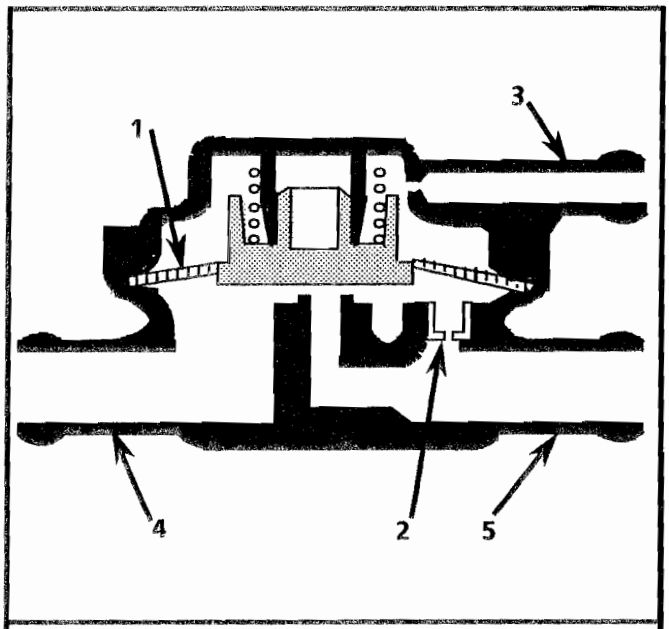


1	PURGE VALVE	4	VAPOR FROM FUEL TANK
2	CONTROL VACUUM SIGNAL	5	AIR INLET / DRAIN TUBE
3	PCV TUBE		6S 2930-6E

Figure C3-1 - Fuel Vapor Canister

FUEL TANK PRESSURE CONTROL VALVE

The Fuel Tank Pressure Control Valve is a spring-biased vacuum diaphragm valve, normally closed, (Figure C3-2). When the engine is running and the throttle is above a specified opening, vacuum is applied to the valve and the valve is opened. Fuel vapors are now free to vent to the canister. When the engine is shut off or the throttle closes below the specified point, no vacuum is applied to the valve, and the fuel tank is vented through the restriction valve. This restriction tends to hold vapor in the tank rather than allowing the vapor into the canister.



1 DIAPHRAGM
2 VENT RESTRICTION
3 CONTROL VACUUM TUBE
4 TUBE TO FUEL TANK
5 TUBE TO CANISTER

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Figure C3-2 - Fuel Tank Pressure Control Valve

RESULTS OF INCORRECT OPERATION

- Poor idle, stalling and poor driveability can be caused by:
  - Inoperative purge solenoid
  - Damaged canister
  - Hoses split, cracked and, or not connected to the proper tubes.
- Evidence of fuel loss or fuel vapor odor can be caused by:
  - Liquid fuel leaking from fuel lines or fuel pump.
  - Cracked or damaged canister
  - Inoperative canister control valve
  - Disconnected, misrouted, kinked, deteriorated or damaged vapor hoses, or control hoses.

If the solenoid is open, or is not receiving power, the canister can purge to the intake manifold at the incorrect time. This can allow extra fuel during warm-up, which can cause rough or unstable idle.

DIAGNOSIS

VISUAL CHECK OF CANISTER

- Cracked or damaged, replace canister.

FUNCTIONAL TEST OF CANISTER PURGE VALVE AND TANK PRESSURE CONTROL VALVE

Apply a short length of hose to the lower tube of purge valve, and attempt to blow through it. No air should pass into the canister.

With hand vacuum pump, apply vacuum 15"Hg. (51 kPa) through the control valve tube (upper tube). The diaphragm should hold vacuum for at least 20 seconds, if not, the canister or control valve must be replaced. If the diaphragm holds vacuum, again try to blow through the hose connected to the lower tube while vacuum is still being applied. An increased flow of air should be observed. If not, the canister or control valve must be replaced.

CANISTER PURGE SOLENOID

The canister purge solenoid operation is covered in Chart C-3 at the end of this section.

ON-CAR SERVICE

FUEL VAPOR CANISTER

Remove or Disconnect

1. Hoses from canister. Mark hoses to install on new canister.
2. Canister.

Install or Connect

1. Canister.
2. Hoses; make sure connections are correct.

CONTROL VALVE

Remove or Disconnect

1. Hoses from valve. Mark hoses to install on new valve.
2. Valve.

Install or connect.

1. Valve.
2. Hoses; make sure connections are correct.

CANISTER HOSES

Refer to Vehicle Emission Control Information Label for routing of canister hoses. When replacing hoses, use 6148M or its equivalent.

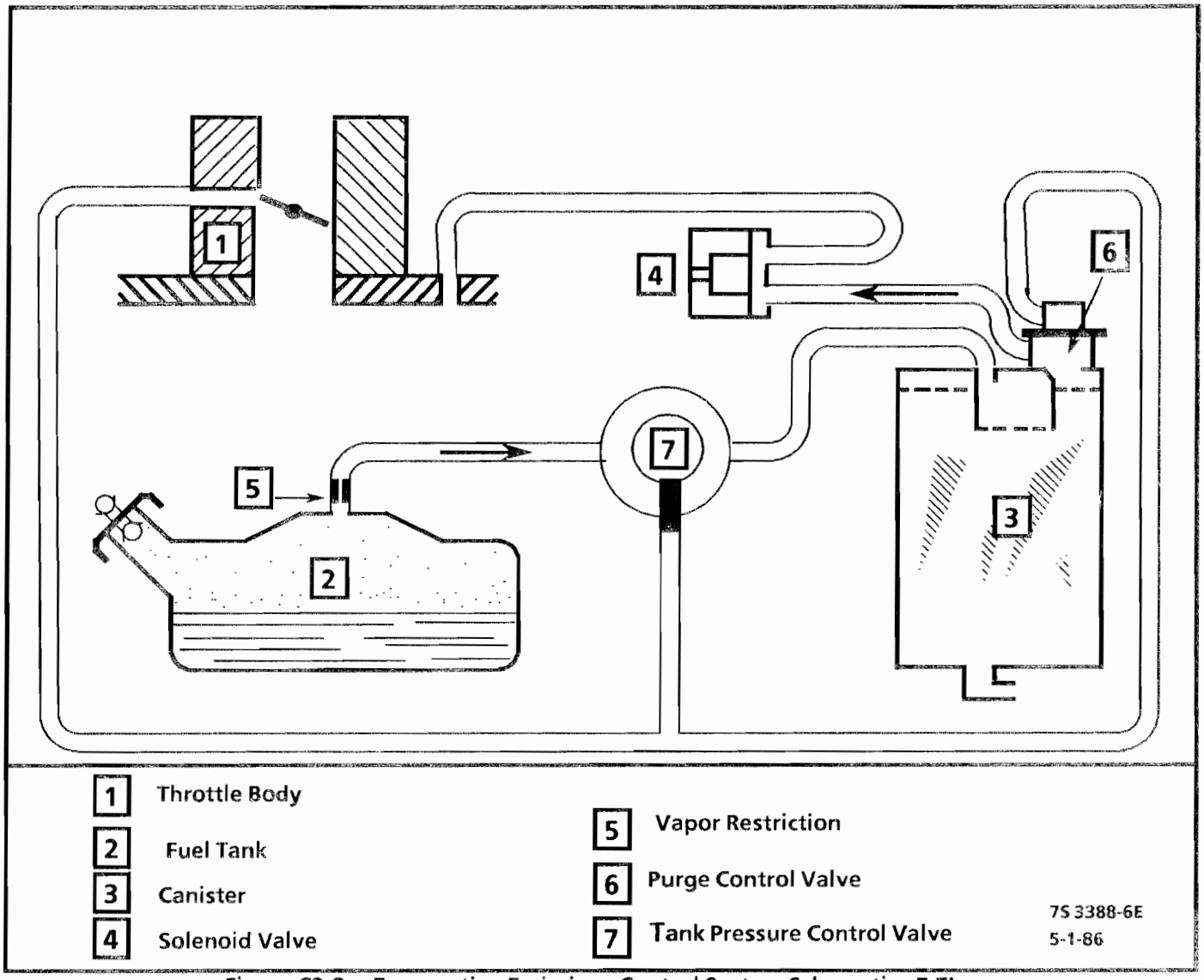


Figure C3-3 - Evaporative Emissions Control System Schematic - 5.7L

CANISTER PURGE SOLENOID

Remove or Disconnect

1. Negative battery cable.
2. Bolt, cover, and solenoid.
3. Electrical connector and hoses from solenoid.
4. Solenoid.

Install or Connect

1. Solenoid, cover, and bolt.
2. Hoses and electrical connector on solenoid.
3. Negative battery cable.

PARTS INFORMATION

PART NAME	GROUP
Canister, Fuel Vapor	3.130
Solenoid, Fuel Vapor Canister purge	3.140
Valve, Tank Pressure Control	3.130

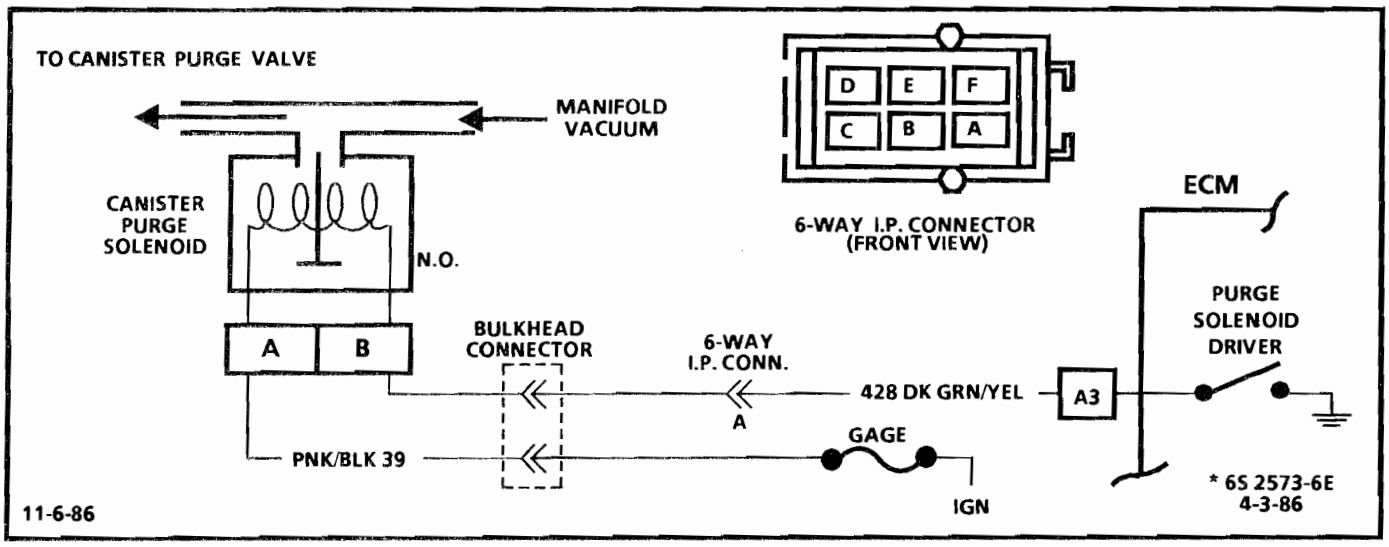


CHART C-3

CANISTER PURGE VALVE CHECK 5.7L "Y" SERIES (PORT)

Circuit Description:

Canister purge is controlled by a solenoid that allows manifold vacuum to purge the canister when de-energized. The ECM supplies a ground to energize the solenoid (purge "OFF").

If the diagnostic test terminal is ungrounded with the engine stopped, or the following is met with the engine running, the purge solenoid is de-energized (purge "ON").

- Engine run time after start more than 1 minute.
- Coolant temperature above 75°C.
- Vehicle speed above 2 mph.
- Throttle off idle.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Checks to see if the solenoid is opened or closed. The solenoid is normally energized in this step, so it should be closed.
2. Checks for a complete circuit. Normally, there is ignition voltage on CKT 39 and the ECM provides a ground on CKT 428. A shorted solenoid could cause an open circuit in the ECM.
3. Completes functional check by ungrounding test terminal. This should normally de-energize the solenoid and allow the vacuum to drop (purge "ON").

CHART C-3

CANISTER PURGE VALVE CHECK 5.7L "Y" SERIES (PORT)

NOTE: THIS CHART ONLY COVERS THE SOLENOID PORTION OF THE CANISTER CONTROL PURGE SYSTEM. TO TEST THE CONTROL VALVE(S) SEE DIAGNOSIS UNDER GENERAL DESCRIPTION

(1)
- IGNITION "ON". ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL .
- DISCONNECT VACUUM HOSES FROM PURGE SOLENOID.
- AT THE SOLENOID, APPLY VACUUM (10" Hg OR 34 kPa) TO THROTTLE BODY SIDE OF PURGE SOLENOID.

UNABLE TO GET 10" Hg OR 34 kPa OF VACUUM .

(2) DISCONNECT PURGE SOLENOID. CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS.

NO LIGHT

- PROBE EACH HARNESS CONNECTOR TERMINAL WITH A TEST LIGHT TO GROUND..

LIGHT ON ONE TERMINAL.

OPEN CKT 428, FAULTY CONNECTION OR FAULTY ECM.

LIGHT BOTH TERMINALS.

REPAIR SHORT TO VOLTAGE IN CKT 428.

NO LIGHT

CHECK FOR OPEN CKT 39.

LIGHT

FAULTY SOLENOID CONNECTOR OR SOLENOID.

ABLE TO GET 10" Hg OR 34 kPa OF VACUUM.

(3)
- UNGROUND DIAGNOSTIC TERMINAL.
- NOTE VACUUM.

NO DROP

- DISCONNECT SOLENOID.

DROPS

PROBE CKT 428 WITH A TEST LIGHT TO 12 VOLTS.

LIGHT "ON"

CKT 428 SHORTED TO GROUND OR FAULTY ECM.

LIGHT "OFF"

FAULTY SOLENOID

NO DROP

REPLACE SOLENOID.

DROPS

NO TROUBLE FOUND.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT

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SECTION C4

IGNITION SYSTEM / EST

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DIAGNOSIS C4-1
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SETTING TIMING C4-2
How Code 42 is Determined C4-2
PARTS INFORMATION C4-2

GENERAL DESCRIPTION

PURPOSE

The High Energy Ignition (HEI) system controls fuel combustion by providing a spark to ignite the compressed air/fuel mixture at the correct time. To provide improved engine performance, fuel economy, and control of exhaust emissions, the ECM controls distributor spark advance (timing) with the Electronic Spark Timing (EST) system.

Only the Electronic Spark Timing (EST) system will be described here. Additional information on the HEI system is found in Section "6D".

To properly control ignition/combustion timing the ECM needs to know:

- Crankshaft position
- Engine speed (rpm)
- Mass Air Flow
- Engine temperature

OPERATION

The EST system consists of the distributor module, ECM, and connecting wires. The connector terminals are lettered as shown in Chart C-4A.

These circuits perform the following functions:

- Distributor reference (CKT 430).

This provides the ECM with rpm and crankshaft position information. If the wire becomes open or grounded, the engine will not run, because the ECM will not operate the injectors. If the engine cranks but won't run, start with CHART A-3.

- Reference ground (CKT 453).

This wire is grounded in the distributor and makes sure the ground circuit has no voltage drop between the distributor and the ECM, which could affect performance. If it is open, it may cause poor performance.

- Bypass (CKT 424).

At about 400 rpm, the ECM applies 5 volts to this circuit to switch spark timing control from the HEI module to the ECM. The wire goes through a connector between the 4 wire connector and the ECM. This is disconnected to set base timing. An open, or grounded bypass circuit, will set a Code 42 and the engine will run at base timing, plus a small amount of advance built into the HEI module.

- EST (CKT 423).

This circuit triggers the HEI module, after the engine is started and no Code 42 detected. The ECM does not know what the actual timing is, but it does know when it gets the reference signal. It then advances or retards the spark from that point. Therefore, if the base timing is set incorrectly, the entire spark curve will be incorrect.

Results of Incorrect Operation

An open or ground in the EST, or bypass, circuit will set a Code 42 and cause the engine to run on the HEI module timing. This will cause reduced performance and poor fuel economy.

The ECM uses information from the MAF and coolant sensors in addition to rpm to calculate spark advance as follows:

- Cold engine = more spark advance.
- Engine under minimum load based on rpm and low amount of air flow- more spark advance.
- Hot engine = less spark advance.
- Engine under heavy load based on rpm and high amount of air flow- less spark advance.

DIAGNOSIS

The description, operation and repair procedures of the HEI system are found in Section "6D" of this manual. For an ignition system check, refer to Chart C-4A.

CODE 12

Code 12 is used during the Diagnostic Circuit Check procedure to test the code display ability of the ECM. This code indicates that the ECM is not receiving the engine rpm (REFERENCE) signal. This occurs with the ignition key "ON" and the engine not running.

The "Reference" signal, also, triggers the fuel injection system. Without the "Reference" signal, the engine cannot run. This signal can be checked by using a "Scan" tool, which will help determine the cause of an engine that cranks but won't start.

ON-CAR SERVICE

SETTING TIMING

The initial base timing is set by disconnecting the timing connector. Then set the timing to the specification shown on Emission Control Information Label. This will cause Code 42 to store in the code memory of the ECM. The memory must be cleared after setting timing.

How Code 42 Is Determined

When the system is running on the HEI module, that is, no voltage on the bypass line, the HEI module grounds the EST signal. The ECM expects to see no voltage on the EST line during this condition. If it sees a voltage, it sets Code 42 and will not go into the EST mode.

When the rpm for EST is reached (about 400 rpm) the ECM applies 5 volts to the bypass line and the EST should no longer be grounded in the HEI module so the EST voltage should be varying.

If the bypass line is open or grounded, the HEI module will not switch to EST mode, so the EST voltage will be low and Code 42 will be set.

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM (Remanufactured)	3.670
Distributor	2.361
Module, Distr	2.383
Coil, Distr	2.170

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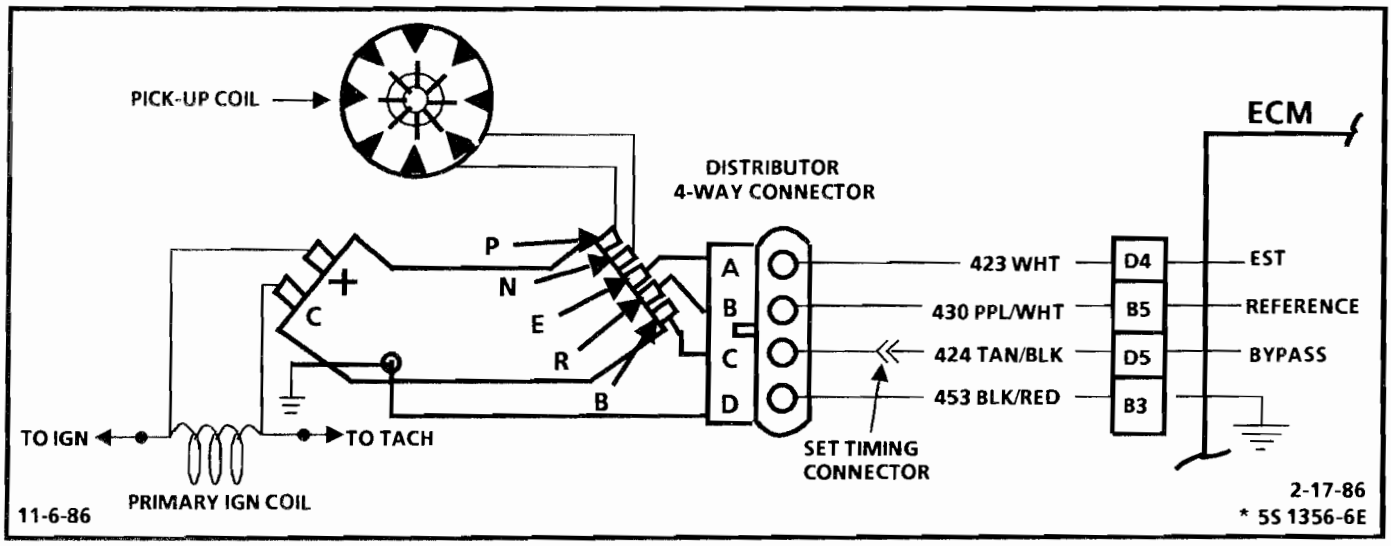


CHART C-4A

IGNITION SYSTEM CHECK
(INTEGRAL COIL)
5.7L "Y" SERIES (PORT)

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. Checks for proper output from the ignition system. The spark tester requires a minimum of 25, 000 volts to fire. This check can be used in case of an ignition miss, because the system may provide enough voltage to run the engine but not enough to fire a spark plug under heavy load.

1A. If spark occurs with EST connector disconnected, pick-up coil output is too low for EST operation.

2. Normal reading during cranking is about 8-10 volts.
3. Checks for a shorted module or grounded circuit from the ignition coil to the module. The distributor module should be turned "OFF", so normal voltage should be about 12 volts. If the module is turned "ON", the voltage would be low, but above 1 volt. This could cause the ignition coil to fail from excessive heat. With an open ignition coil primary winding, a small mount of voltage will leak through the module from the battery to the tach. terminal.
4. Checks the voltage output with the pick-up coil triggering the module. A spark indicates that the ignition system has sufficient output, however, intermittent no-starts or poor performance could be the result of incorrect polarity between the ignition coil and the pick-up coil .
   The color of the pick-up coil connector has to be yellow, if one of the ignition coil leads is yellow. If the ignition coil has a white lead, any pick-up coil connector color, except yellow, is OK.
5. Checks for an open module or circuit to it. 12 volts applied to the module "P" terminal should turn the module "ON" and the voltage should drop to about 7-9 volts.
6. This should turn "OFF" the module and cause a spark. If no spark occurs, the fault is most likely in the ignition coil, because most module problems would have been found before this point in the procedure. A module tester could determine which is at fault.

CHART C-4A
IGNITION SYSTEM CHECK
(INTEGRAL COIL)
5.7L "Y" SERIES (PORT)

1
- Perform diagnostic circuit check before proceeding with this test.
- If a tachometer is connected to the "Tach." term., disconnect it before proceeding with the test. (Intermittent no start may be caused by wrong pick-up or ign. coil)
- Check spark at plug with spark tester J-26792 or equivalent (ST-125) while cranking (if no spark on one wire, check a second wire). A few sparks and then nothing, is considered no spark.

No Spark → **1A**

1A
- Disconnect 4 term. EST connector and check for spark.

No spark → **2**

2
- Check voltage at distributor "Bat." terminal while cranking.

7 Volts or more → **3**

3
- With ignition on, check voltage at "Tach." terminal

Over10 volts → **4**

4
- Check for spark at coil output terminal with spark tester (ST-125) while cranking. (Fig. 1)

No spark → **5**

5
- Remove pick-up coil leads from module.
- Ignition "on", Engine stopped.
- Observe voltage at "Tach." terminal as test light is momentarily connected from Bat. + to module term. "P". (Fig. 3) Don't touch for more than 5 seconds.

Voltage drops → **6**

6
- Check for spark again from coil output terminal with spark tester (ST-125) as test light is removed from module term.

No Spark
- If no module tester is available; Replace ign. coil and repeat Step 5.

No Spark
Ign. coil removed is OK, reinstall original coil and replace dist. module.

Spark
System OK

Spark
Check pick-up coil or conns. (Coil resistance should be 500-1500 ohms and not grounded).

- If module tester is available: test module

OK
Check coil wire from cap to coil. If OK, replace coil.

Not OK
Replace module

No drop in voltage
Check module ground and for open in wires from coil to module. If OK, replace module.

Spark
Check color match of pick-up coil connector and ign. coil lead. (Fig. 4 & Fig. 5) Inspect cap for water, cracks, etc. If ok replace rotor.

Under 7 volts
Repair primary circuit to ignition switch

Under 1 volt
Repair faulty coil connection or replace faulty ignition coil

1 to 10 volts
Replace module and check for spark from coil as in Step 6.

Spark
System OK

No Spark
Replace ign. coil, it too is faulty

Spark
Replace pick-up coil

Spark
Check fuel,spark plugs, etc. See section "B" symptoms.

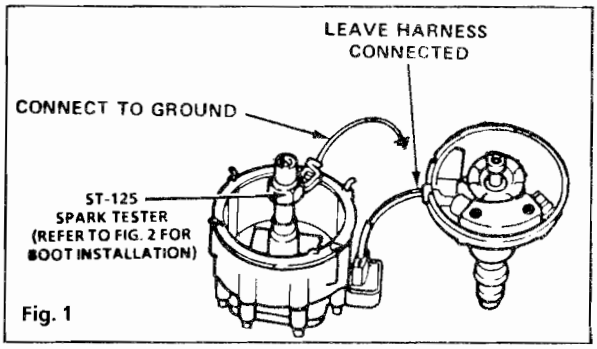


Fig. 1

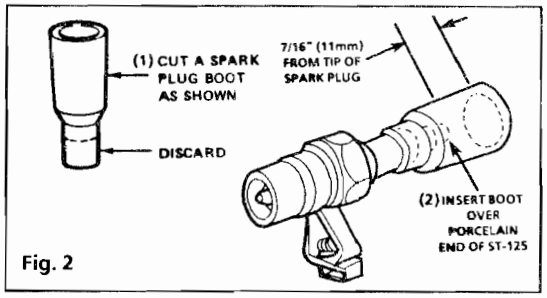


Fig. 2

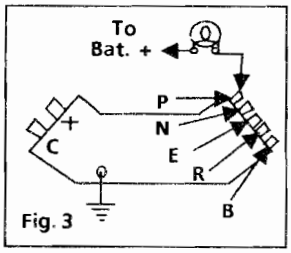


Fig. 3

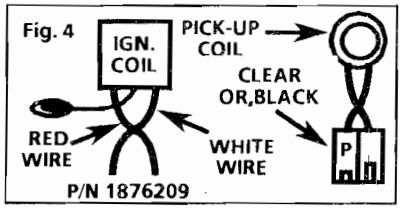


Fig. 4
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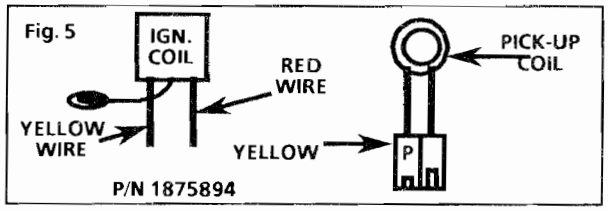


Fig. 5
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SECTION C5

ELECTRONIC SPARK CONTROL (ESC) SYSTEM

CONTENTS

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GENERAL DESCRIPTION C5-1
DIAGNOSIS C5-1
ON-CAR SERVICE C5-1
ESC SENSOR C5-1
ESC MODULE & BRACKET C5-2
PARTS INFORMATION C5-2

GENERAL DESCRIPTION

PURPOSE

Varying octane levels in today's gasoline can cause detonation in high performance engines. Detonation is sometimes called spark knock. This condition causes the pistons and rings to vibrate and rattle producing the spark knocking sound.

To control spark knock an Electronic Spark Control (ESC) system is used. This system is designed to retard spark timing up to 20° to reduce spark knock in the engine. This allows the engine to use maximum spark advance to improve driveability and fuel economy.

GENERAL DESCRIPTION

The ESC system has two major components:

- ESC Module
- ESC Knock Sensor

The ESC knock sensor detects abnormal vibration (spark knocking) in the engine. The sensor is mounted in the engine block near the cylinders. The ESC module receives the knock sensor information and sends a signal to the ECM. The ECM then adjusts the electronic spark timing (EST) to reduce spark knocking.

The ESC module sends a voltage signal (8 to 10 volts) to the ECM, when NO spark knock is detected by the ESC knock sensor, and the ECM provides normal spark advance.

When the knock sensor detects spark knock, the module turns "OFF" CKT 485 to the ECM. The ECM then retards EST to reduce spark knock.

Loss of the ESC knock sensor signal or loss of ground at ESC module terminal "D" would cause the signal on CKT 485 to the ECM to remain high. This condition would cause the ECM to control EST as if no spark knock was happening. No retard would occur, and spark knock could become severe under heavy engine load conditions. This condition should, however, cause a Code 43 to set.

Loss of the ESC signal to the ECM would cause the ECM to constantly retard EST. This could result in sluggish performance and cause a Code 43 to set.

DIAGNOSIS

Code 43 indicates that the ECM terminal "B7" is receiving less than 6 volts for a 4 second period with the engine running. This is CKT 485, which normally provides a 8 to 10 volt signal from the ESC module to the ECM. See CODE 43 CHART for diagnosis if the code is present.

When no Code 43 is present, but the ESC system is a potential cause of excessive spark knock, see CHART C-5 which follows.

"Scan" tools have two positions to diagnose the ESC System. The "Knock Signal" can be monitored to determine if the knock sensor is detecting a knock condition and if the ESC module is functioning. The "Knock Retard" position, on a "Scan", displays the amount of spark retard the ECM is commanding.

ON-CAR SERVICE

ESC SENSOR

Remove or Disconnect

1. Negative battery cable.
2. Raise car.
3. ESC wiring harness connector from ESC sensor.
4. ESC sensor from engine block.

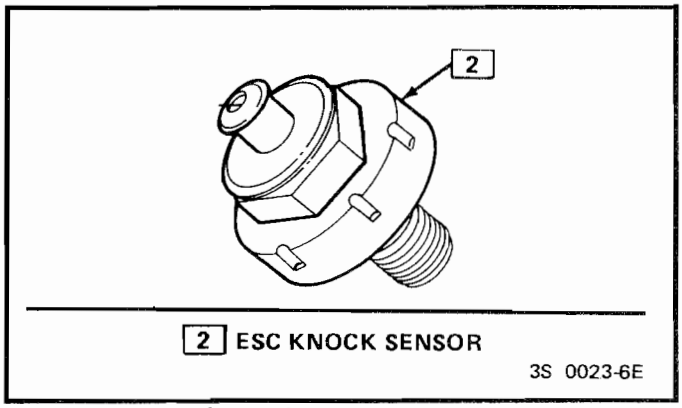


Figure C5-1 ESC Sensor

Important

Apply thread sealer, such as soft sealing tape, to the ESC sensor threads.

Install or Connect

1. ESC sensor into engine block.
   - Tighten to 14 ft. lbs. (19 N•m).
2. ESC wiring harness connector to the ESC sensor.
3. Lower car.
4. Negative battery cable.

ESC MODULE AND BRACKET

Refer to Figure C5-2 for ESC module replacement.

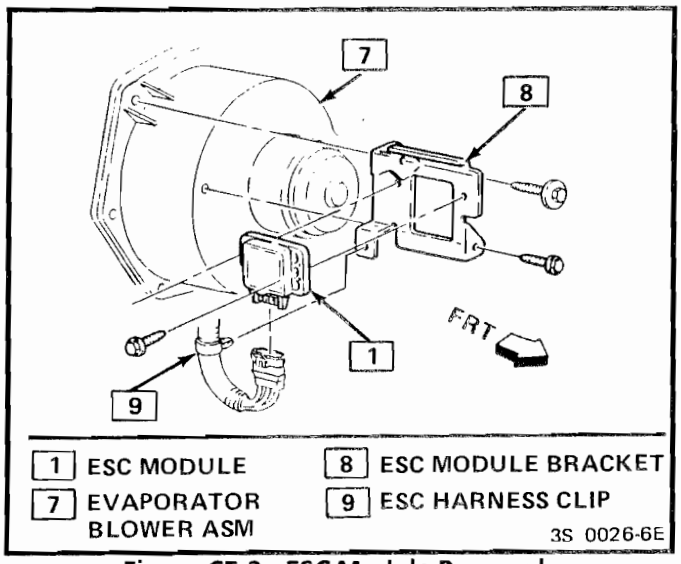


Figure C5-2 ESC Module Removal

PARTS INFORMATION

PART NAME	GROUP
Sensor, ESC Knock	2.383
Module, Elek Spark Cont	2.383
Bracket, Elek Spark Cont Mdl	2.383
Shield, Elek Spark Cont Knock	2.383

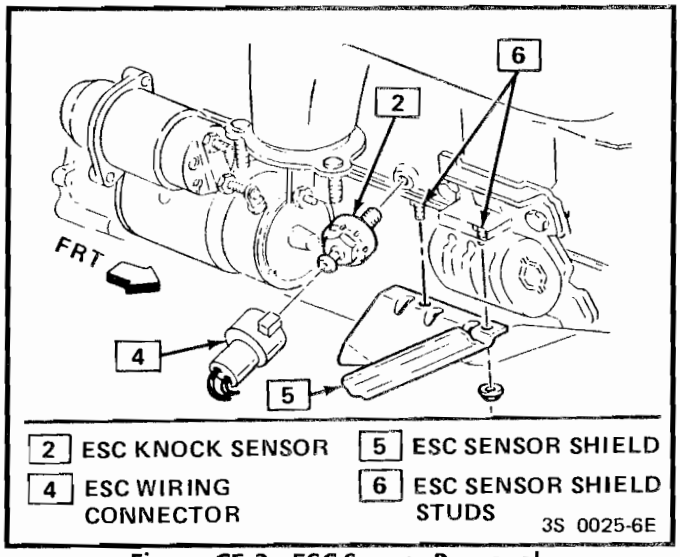


Figure C5-3 ESC Sensor Removal

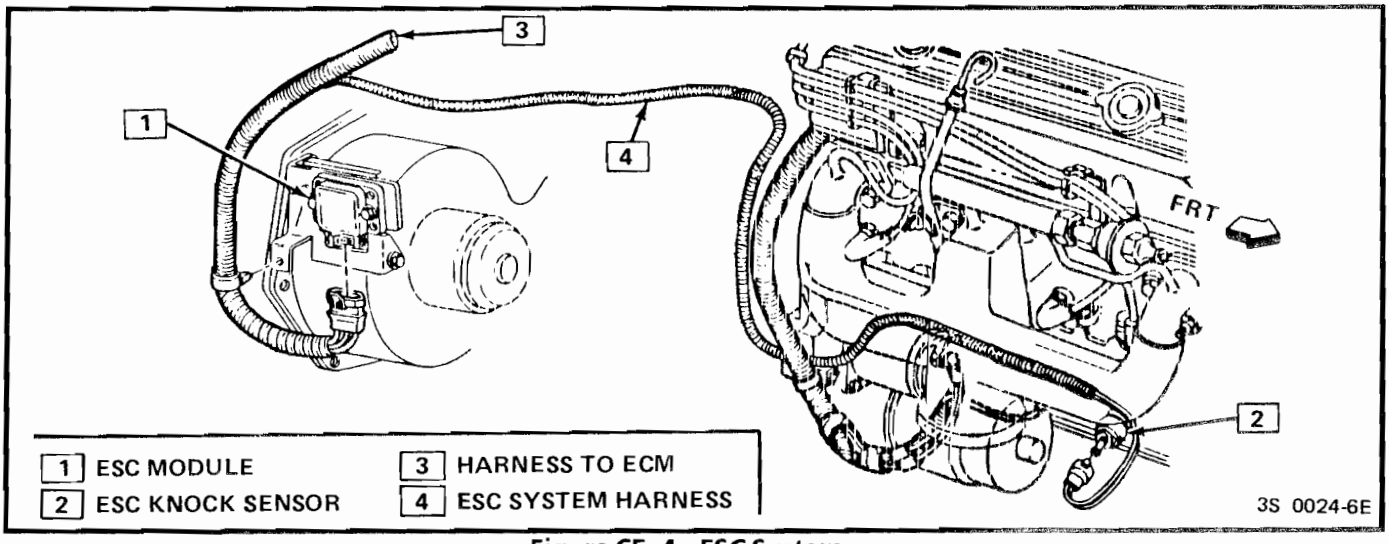


Figure C5-4 ESC System

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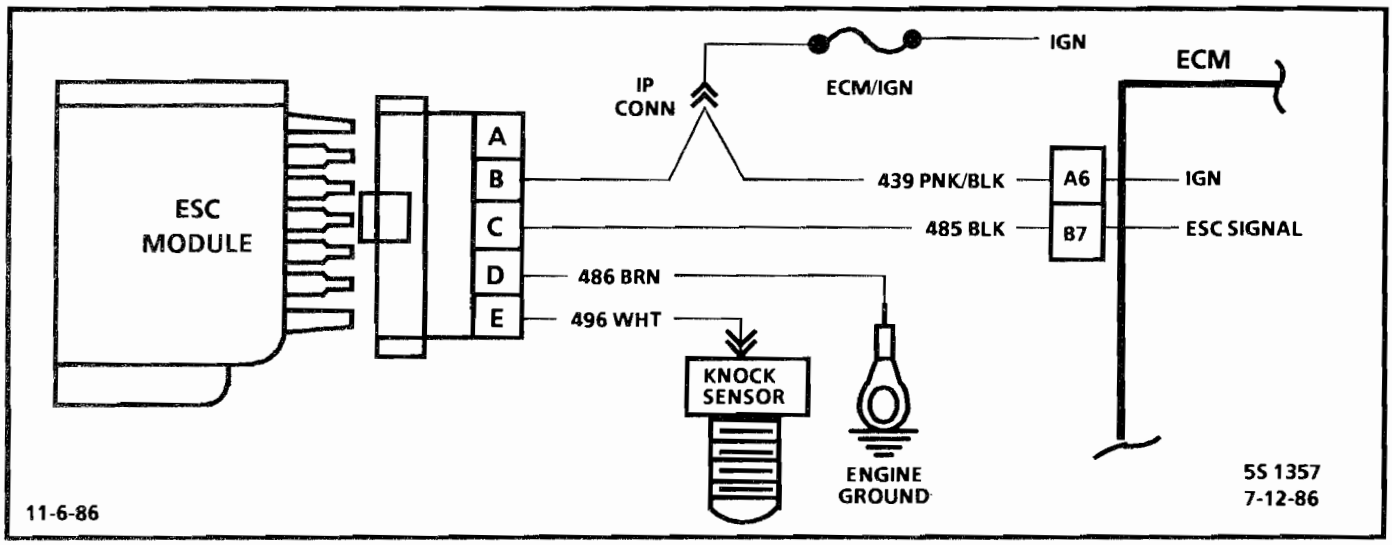


CHART C-5

ELECTRONIC SPARK CONTROL (ESC) SYSTEM CHECK (ENGINE KNOCK, POOR PERFORMANCE, OR POOR FUEL ECONOMY) 5.7L "Y" SERIES (PORT)

Circuit Description:

Electronic spark control is accomplished with a module that sends a voltage signal to the ECM. As the knock sensor detects engine knock, the voltage from the ESC module to the ECM is shut "OFF" and this signals the ECM to retard timing, if engine rpm is over about 850.

Test Description: Step numbers refer to step numbers in diagnostic chart.

1. If a Code 43 is not set, but a knock signal is indicated while running at 1500 rpm, listen for an internal engine noise. Under a no load condition, there should not be any detonation, and if knock is indicated, an internal engine problem may exist.
2. Usually a knock signal can be generated by tapping on the right exhaust manifold. This test can also be performed at idle. Test number 1 was run at 1500 rpm to determine if a constant knock signal was present, which would affect engine performance.
3. This tests whether the knock signal is due to the sensor, a basic engine problem, or the ESC module.
4. If the module ground circuit is faulty, the ESC module will not function correctly. The test light should light, indicating the ground circuit is OK.
5. Contacting CKT 496, with a test light to 12 volts, should generate a knock signal to determine whether the knock sensor is faulty, or the ESC module can't recognize a knock signal.

Diagnostic Aids:

"Scan" tools have two positions to diagnose the ESC system. The knock signal can be monitored to see if the knock sensor is detecting a knock condition and, if the ESC module is functioning, knock signal should display "yes" whenever detonation is present. The knock retard position on the "Scan" displays the amount of spark retard the ECM is commanding. The ECM can retard the timing up to 20 degrees.

If the ESC system checks OK, but detonation is the complaint, refer to Detonation/Spark knock in Section "B".

CHART C-5

ELECTRONIC SPARK CONTROL (ESC) SYSTEM CHECK
(ENGINE KNOCK, POOR PERFORMANCE, OR POOR FUEL ECONOMY)
5.7L "Y" SERIES (PORT)

THIS CHART SHOULD BE USED AFTER ALL OTHER CAUSES OF SPARK KNOCK HAVE BEEN CHECKED. I.E., TIMING, EGR, ENGINE TEMPERATURE OR EXCESSIVE ENGINE NOISE,ETC. IF CODE 43 IS SET, USE THAT CHART FIRST.

(1)
- IF A CODE 43 WAS SET USE THAT CHART FIRST. THIS CHART ASSUMES CODE 43 IS NOT PRESENT.
- "SCAN" TOOL SET ON KNOCK SIGNAL.
- ENGINE RUNNING AT ABOUT 1500 RPM.
- IS THERE A KNOCK SIGNAL INDICATED?

NO

(2)
- ENGINE RUNNING AT 1500 RPM.
- TAP ENGINE BLOCK IN AREA OF KNOCK SENSOR.
- DOES "SCAN" INDICATE A KNOCK SIGNAL WHILE TAPPING ON ENGINE?

NO

(4)
- DISCONNECT ESC MODULE.
- PROBE HARNESS TERM. "D" (CKT 486) WITH A TEST LIGHT TO 12 V.

LIGHT "ON"

(5)
- RECONNECT ESC MODULE.
- DISCONNECT KNOCK SENSOR.
- ENGINE IDLING.
- MOMENTARILY TOUCH KNOCK SENSOR HARNESS (CKT 496) WITH A TEST LIGHT TO 12V.
- EACH TIME THE TEST LIGHT CONTACTS CKT 496, A KNOCK SIGNAL SHOULD BE GENERATED.
- IS A KNOCK SIGNAL INDICATED WITH "SCAN"?

YES

FAULTY CONNECTION AT SENSOR OR FAULTY KNOCK SENSOR.

NO

CKT 496 OPEN, SHORTED TO GROUND, FAULTY CONNECTION AT ESC MODULE, OR FAULTY ESC MODULE.

LIGHT "OFF"

REPAIR OPEN GND CKT 486.

YES

ESC SYSTEM OK.

YES

(3)
- DISCONNECT KNOCK SENSOR.
- REPEAT TEST.
- IS THERE A KNOCK SIGNAL INDICATED?

YES

CHECK FOR ROUTING OF WIRE FROM KNOCK SENSOR TO ESC MODULE FOR PICKING UP FALSE KNOCK SIGNALS FROM AN ADJACENT WIRE. REROUTE AS NECESSARY. IF ROUTING IS CORRECT, REPLACE ESC MODULE.

NO

INTERNAL ENGINE KNOCK OR FAULTY SENSOR.

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SECTION C6

AIR INJECTION REACTION (A.I.R.) SYSTEM

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PURPOSE C6-1
AIR INJECTION REACTION SYSTEM C6-1
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GENERAL DESCRIPTION

PURPOSE

This system is used to reduce carbon monoxide (CO), hydrocarbon (HC) and oxides of nitrogen (NOx) emissions. It also heats up the catalytic converter quickly on engine start-up, so conversion of exhaust gases will start quickly.

A dual bed converter is used. It consists of a three way catalyst (which controls all three emissions) in series with a two way catalyst (which controls only HC and CO). Both are in one housing. A pipe between the two converters allows air to be injected into the second (two way) converter to increase its efficiency to further control HC and CO.

AIR INJECTION REACTION (A.I.R.)SYSTEM

A.I.R. Pump Operation

The system (Figure C6-1) includes:

- An Air Pump.
  The air pump is driven by a belt on the front of the engine and supplies the air to the system. Intake air passes through a centrifugal filter fan at the front of the pump; where foreign materials are separated from the air by centrifugal force.
- A Control Valve.
  Air flows from the pump through an ECM controlled valve (called a control valve) through check valves to either the exhaust ports or the converter.
- Check Valves.
  The check valves prevent back flow of exhaust into the pump in the event of an exhaust backfire or pump drive belt failure.
- Necessary Plumbing.

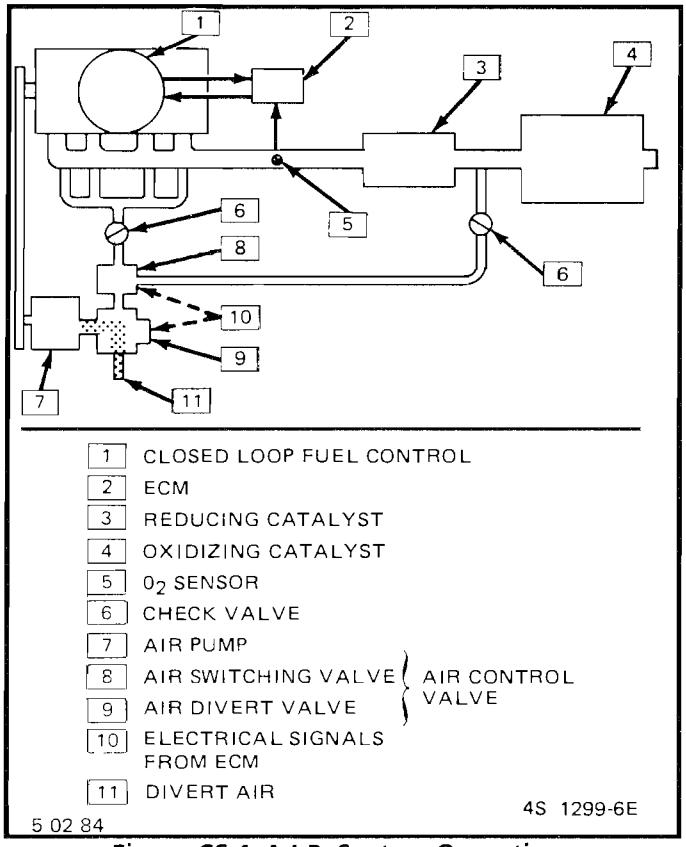


Figure C6-1 A.I.R. System Operation

AIR CONTROL

This system uses vacuum operated, ECM controlled (grounds to complete the circuit and energize the solenoid) valves which combine both the divert function and the A.I.R. switching function as two valves in series. These are the Electric Divert Valve and the Electric Air Switching Valve.

FUNCTION

- The air control (divert) valve provides air divert overboard for converter protection or directs air to the switching valve.

- The air switching valve directs air to the exhaust ports during cold engine operation or anytime the fuel control system is in "Open Loop", and between converter beds during warm engine operation when the fuel control system is in "Closed Loop".
- When divert is needed, the ECM turns "OFF" the solenoid in the air control section of the valve, causing air to be diverted to thesilencer.
- Divert occurs under the following conditions:
  - Rich operating condition.
  - When the ECM recognizes a problem and sets the "Service Engine Soon" light.
  - During deceleration, very high vacuum.
  - High rpm, when air pressure exceedes the setting for relief valve in the air control valve.

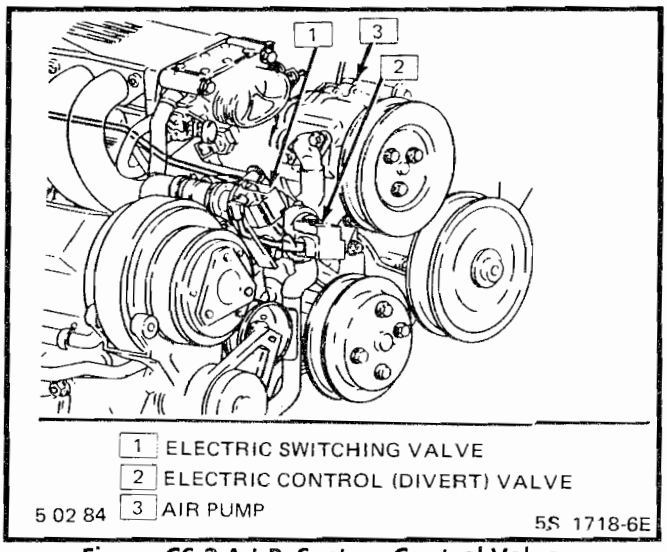


Figure C6-2 A.I.R, System Control Valves

Results of Incorrect A.I.R. System Operation

- If no air (oxygen) flow enters the exhaust stream at the exhaust ports, or the converter pipe, HC and CO emission levels will be too high.
- Air flowing to the exhaust ports at all times could cause a rich ECM command and increased temperature of the converter.
- Air flowing at all times to the catalytic converter may cause converter overheating during rich operation.
- Electrical failure (open circuit) of the control valve will divert airflow overboard at all times. Air will flow to the converter at all times if an open circuit occurs to the switching valve. Mechanical failures in the valves could cause the air to flow incorectly to the exhaust ports or the converter.

DIAGNOSIS

The diagnosis of the AIR system is covered in CHART C-6 at the end of this section.

OPERATIONAL CHECKS
Air Pump

The air pump is a positive displacement vane type which is permanently lubricated and requires no periodic maintenance.

Accelerate engine to approximately 1500 rpm and observe air flow from hose(s). If air flow increases as engine is accelerated, pump is operating satisfactorily. If air flow does not increase or is not present, proceed as follows:

Inspect

1. For proper drive belt tension.
2. For a leaky pressure relief valve. Air may be heard leaking with the pump running.

NOTICE: If the engine or underhood compartment is to be cleaned with steam or high-pressure detergent, the centrifugal filter fan should be masked off, to prevent liquids from entering the pump.

Inspect

3. For a seized Air Injection Pump.
4. Hoses, tubes and all connections for leaks and proper routing.

CAUTION: **Do not oil AIR pump.**

5. For air flow from control/switching valve.
6. AIR injection pump for proper mounting and bolt torque.
7. If no irregularities exist and the AIR injection pump noise is still excessive, remove and replace pump.

Hose and Pipes

Inspect

1. Hose or pipe for deterioration or holes.
2. All hoses or pipe connections, and clamp tightness.
3. Hose or pipe routing. Interference may cause wear.
4. If a leak is suspected on the pressure side of the system, or if a hose or pipe has been disconnected on the pressure side, the connections should be checked for leaks with a soapy water solution. With the pump running, bubbles will form if a leak exists.

Check Valve

Inspect

1. A check valve should be inspected whenever the hose is disconnected from a check valve, or whenever check valve failure is suspected (a pump that had become inoperative, and had shown indications of having exhaust gases in the pump, would indicate check valve failure).
2. Blow through the check valve (toward the exhaust manifold) then attempt to suck back through the check valve. Flow should only be in one direction (toward the exhaust manifold). Replace valve which does not operate properly.

ON-CAR SERVICE

DRIVE BELT

Remove or Disconnect

1. Inspect drive belt for wear, cracks or deterioration and replace if required. When installing new belt, it must be seated and fully secured in grooves of A/C compressor, AIR pump, generator, and crankshaft pulleys.

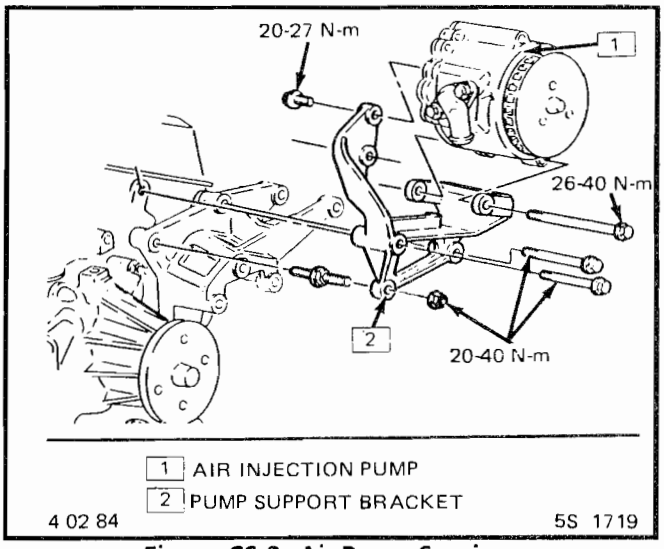


Figure C6-3 Air Pump Service

PUMP CENTRIFUGAL FILTER FAN

The centrifugal filter fan should not be cleaned, either with compressed air or solvents.

CAUTION: **Centrifugal fan should not be removed from pump unless it is damaged, as removal will destroy the fan.**

Before starting replacement note the following:

- Do not allow any filter fragments to enter the air pump intake hole.
- Do not remove filter fan by inserting a screwdriver between pump and filter fan. Damage to sealing lip pump will result.
- Do not remove metal drive hub from filter fan.

AIR INJECTION PUMP

Remove or Disconnect

1. Hold pump pulley from turning by compressing drive belt, then loosen pump pulley bolts.
2. Lift drive tensioner to raised position.
3. Drive belt and pulley.
4. If required, insert needle nose pliers and pull filter fan from hub.
5. Hoses, vacuum and electrical connections, and control valve.
6. Air pump mounting bolts and pump assembly.

Install or Connect

1. Air pump assembly, and tighten mounting bolts.
2. Hoses, vacuum and electrical connections, and control valve.
3. New filter fan on pump hub.
4. Pump pulley against centrifugal filter fan.
5. Pump pulley bolts and tighten equally to 12 N•m (100 in. lbs.). This will compress the centrifugal filter fan onto the pump hole. Do not drive filter fan on with a hammer. A slight amount of interference with the housing bore is normal. After a new filter fan has been installed, it may squeal upon initial operation or until O.D. sealing lip has worn in. This may require a short period of pump operation at various engine speeds.
6. Serpentine belt.
7. Check air injection system for proper operation (see CHART C- 6).

AIR INJECTION CONTROL VALVES

Remove or Disconnect

1. Air outlet hoses and connecting hose from valve.
2. Electrical connectors from valve.
3. Electric Air Switching Valve or Electric Divert Valve.

Install or Connect

1. Electric Air Switching Valve or Electric Divert Valve.
2. Electrical connectors to valve.
3. Air outlet hoses and connecting hose to valve.
4. Check system operation (see CHART C-6).

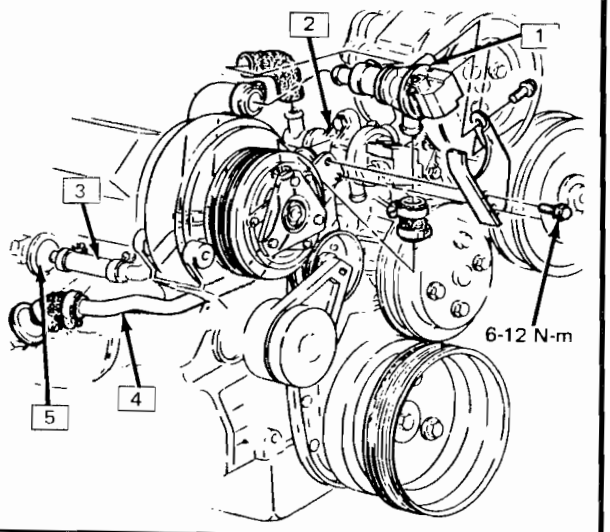
AIR INJECTION ENGINE CHECK VALVE

Remove or Disconnect

1. Release clamp and disconnect air hoses from check valve.
2. Unscrew check valve from air injection pipe.

Install or Connect

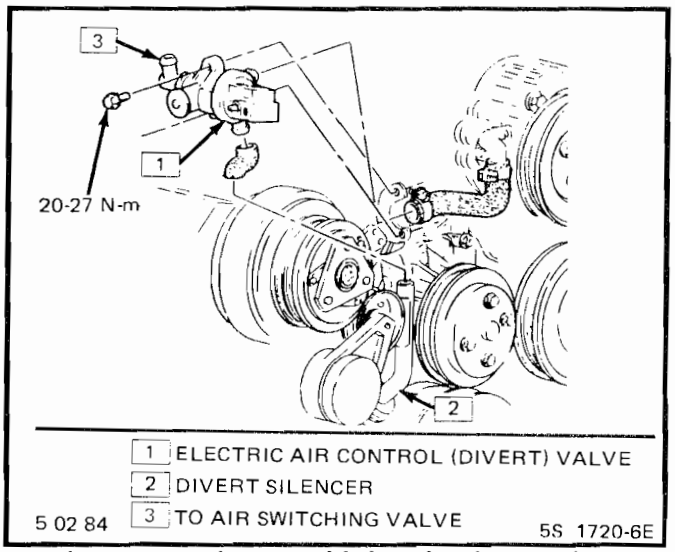
1. Screw check valve onto air injection pipe.
2. Position air hose on check valve and secure with clamp.



1 ELECTRIC SWITCHING VALVE
2 ELECTRIC CONTROL (DIVERT) VALVE
3 TO EXHAUST PORTS
4 TO CONVERTER
5 CHECK VALVE

5 02 84 5S 1721-6E

Figure C6-4 Air Switching (Converter) Valve Service



1 ELECTRIC AIR CONTROL (DIVERT) VALVE
2 DIVERT SILENCER
3 TO AIR SWITCHING VALVE

5 02 84 5S 1720-6E

Figure C6-5 Air Control (Divert) Valve Service

PARTS INFORMATION

PART NAME	GROUP
Adapter, AIR Inj Cont Vlv Hose	3.671
Brace, AIR Inj Pump	3.655
Bracket, AIR Inj Pump	3.655
Fan, AIR Pump	3.665
Gasket, AIR Inj. Dvtr Vlv El	3.665
Hose, AIR Pump	3.675
Hose, AIR Cont Vlv	3.675
Hose, AIR Cont Vlv Dvtr	3.675
Pipe, AIR Eng Chk Vlv	3.675
Pipe, AIR Inj Cont Vlv	3.675
Pipe, Ctltc Conv AIR Inj	3.675
Pulley, AIR Inj Pump	3.650
Pump AIR Inj	3.660
Valve, AIR Inj Eng Chk	3.670
Valve, AIR Inj Control (Divert)	3.670
Valve, AIR Inj Switching	3.670

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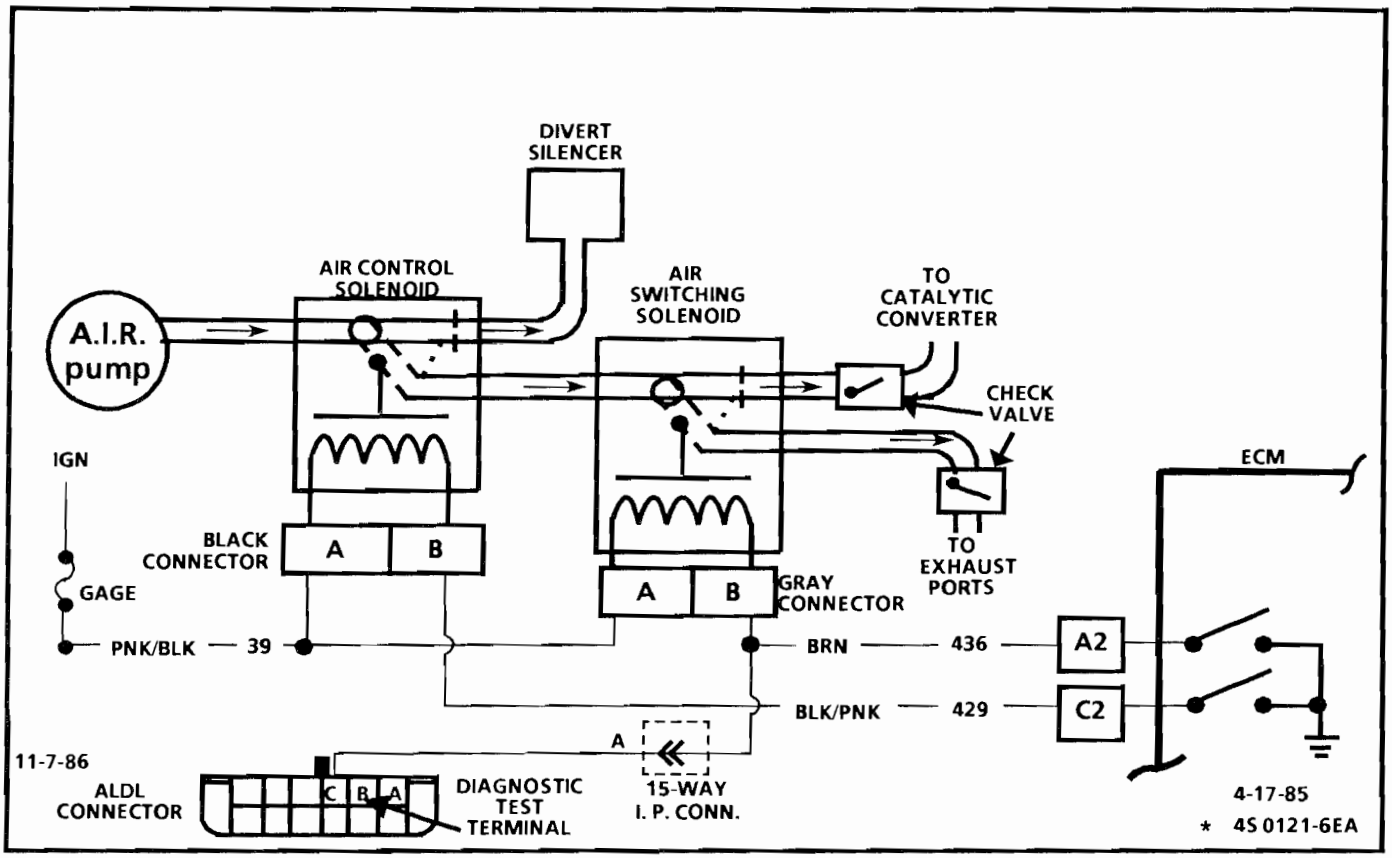


CHART C-6

(Page 1 of 2)
AIR MANAGEMENT CHECK
(ELECTRIC DIVERT/ELECTRIC SWITCHING)
5.7L "Y" SERIES (PORT)

Circuit Description:

Air Management is controlled by an Air Control and Air Switching Valves, each with an ECM controlled vacuum solenoid. When the solenoid is grounded by the ECM, manifold vacuum will activate the valve and allow pump air to be directed as follows:

- Air control solenoid not grounded by the ECM - Air diverted to silencer.
- Air control solenoid grounded by the ECM - Air to Air Switching Valve.
- Air switching solenoid grounded by the ECM - Air to exhaust ports.

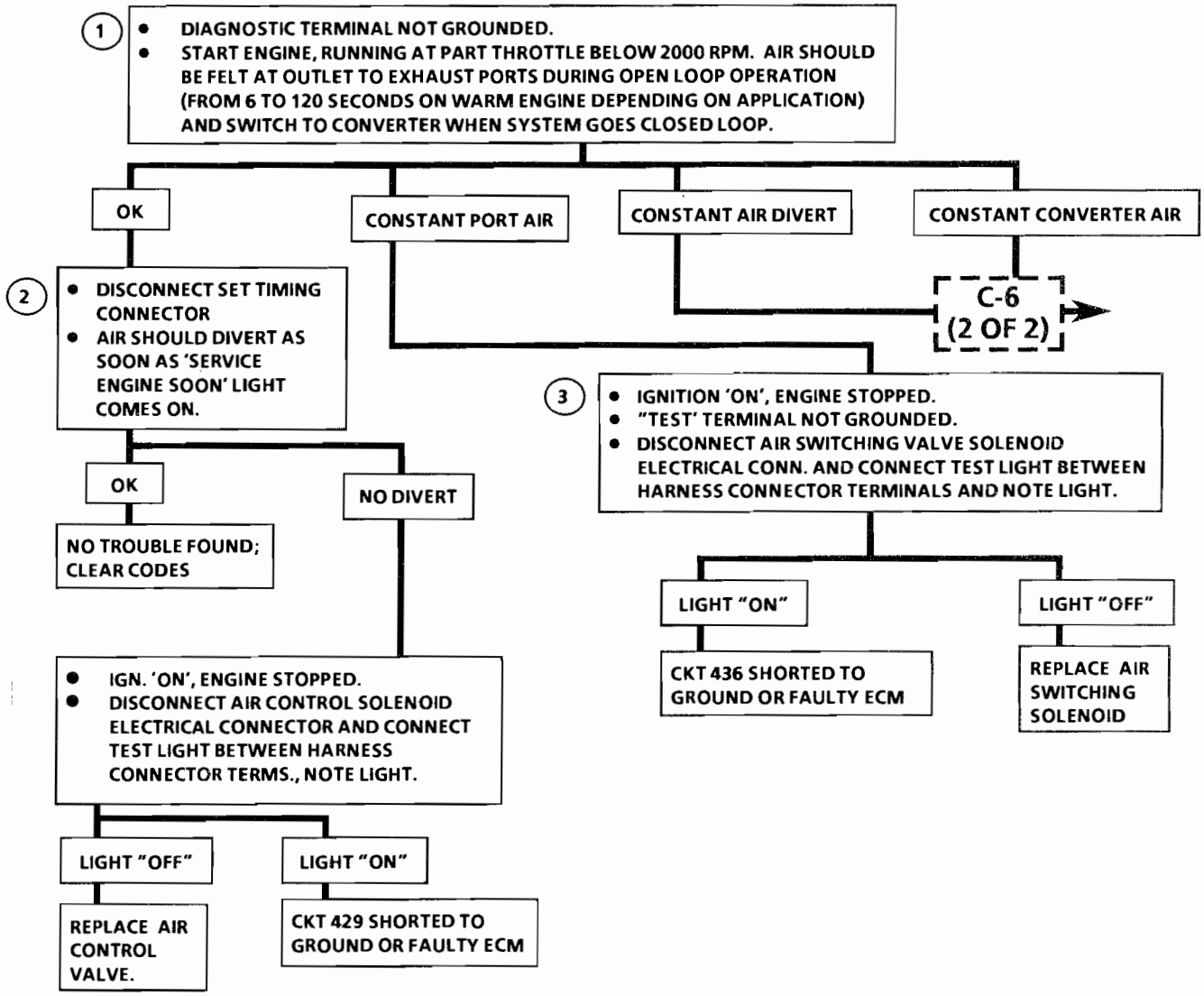
Test Description: The step numbers refer to the step numbers on the diagnostic chart.

1. This is a system functional check. Engine coolant temperature must be below 60°C (140°F). This step checks for air switching from port to converter. Since the air to the port time is very short on some engines, prepare to check for air to ports immediately after engine starts.
2. This will set a Code 42. When a code is set, the ECM opens the ground to the Air Control Valve and allows air to divert. This checks for ECM response to a system faulty.
3. This checks for a grounded circuit to the ECM. Test light "OFF" is normal and would indicate the circuit is not grounded.

CHART C-6

(Page 1 of 2)

AIR MANAGEMENT CHECK
(ELECTRIC DIVERT/ELECTRIC SWITCHING)
5.7L "Y" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

5S 1557
4-4-86

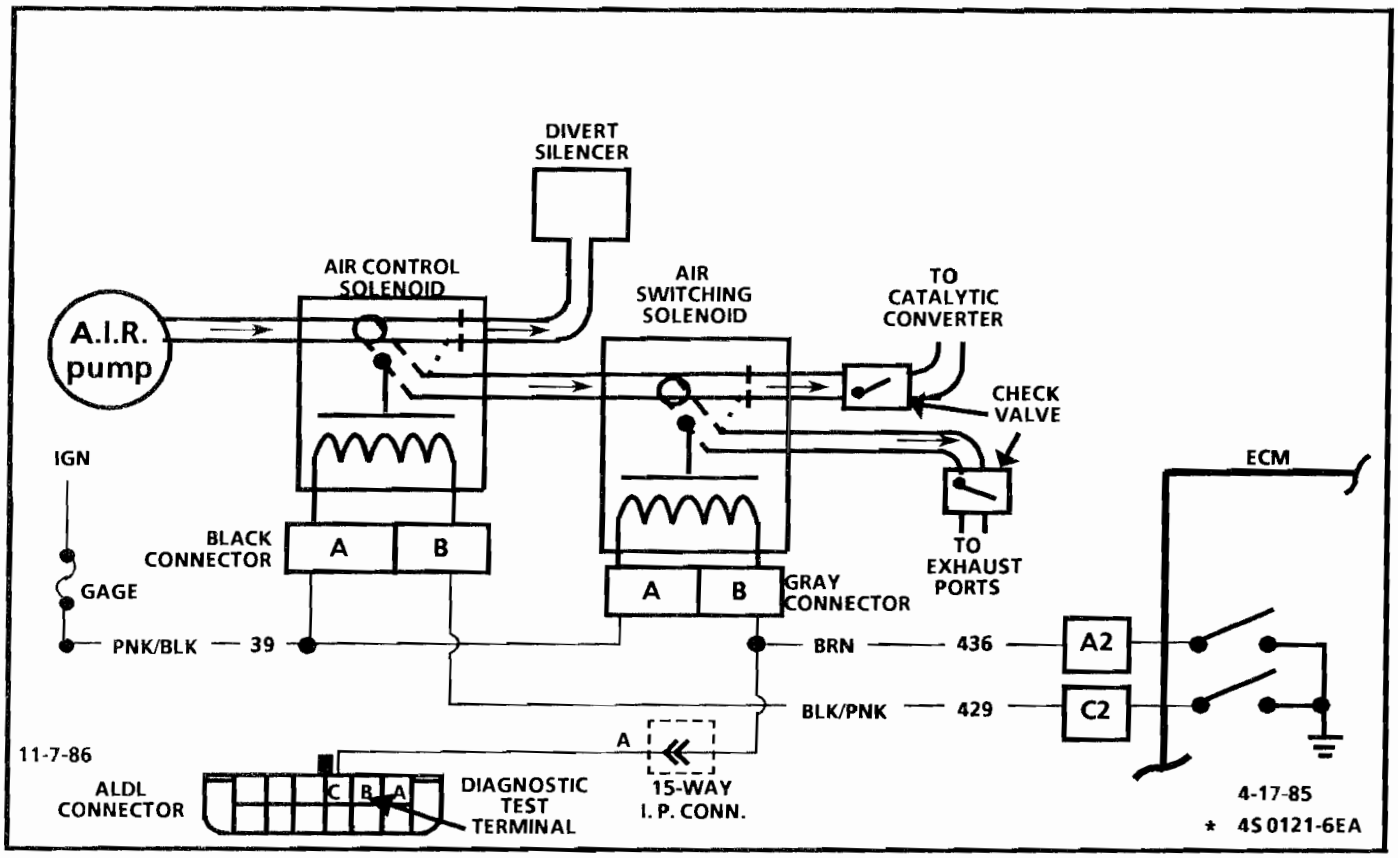


CHART C-6

(Page 2 of 2)
AIR MANAGEMENT CHECK
(ELECTRIC DIVERT/ELECTRIC SWITCHING)
5.7L "Y" SERIES (PORT)

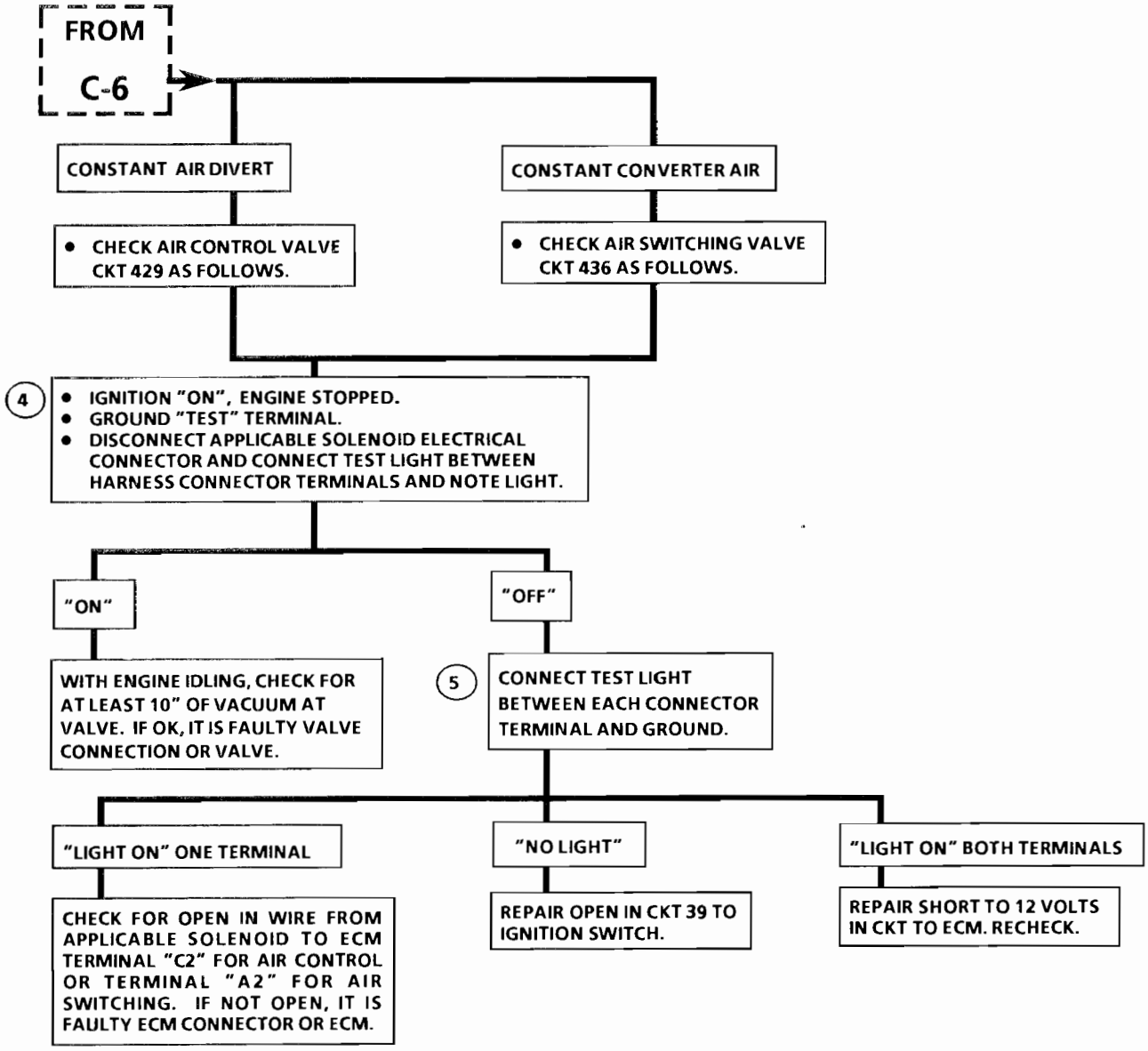
Test Description: The step numbers refer to the step numbers on the diagnostic chart.

4. Checks for an open in the solenoid control circuits. Grounding the test terminal should ground both solenoid circuits. Normally, the test light should be "ON", which indicates the problem is not in the ECM or wiring, but at the solenoid connections or valve itself.
5. Checks for open ignition circuit, ground circuit shorted to 12 volts, or open ground wire. Only one terminal should light the test light.

CHART C-6

(Page 2 of 2)

AIR MANAGEMENT CHECK
(ELECTRIC DIVERT/ELECTRIC SWITCHING)
5.7L "Y " SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP' OPERATION AND NO "SERVICE ENGINE SOON' LIGHT.

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4-17-86

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SECTION C7

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

CONTENTS

GENERAL DESCRIPTION C7-1
PURPOSE C7-1
OPERATION C7-1
EGR CONTROL C7-1
NEGATIVE BACKPRESSURE VALVE C7-1
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EGR VALVE C7-2
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GENERAL DESCRIPTION

PURPOSE

The EGR system is used to lower NOx (oxides of nitrogen) emission levels caused by high combustion temperature. It does this by decreasing combustion temperature.

The main element of the system is the EGR valve mounted on the intake manifold and operated by vacuum.

The EGR valve feeds small amounts of exhaust gas back into the combustion chamber as shown in Figure C7-1.

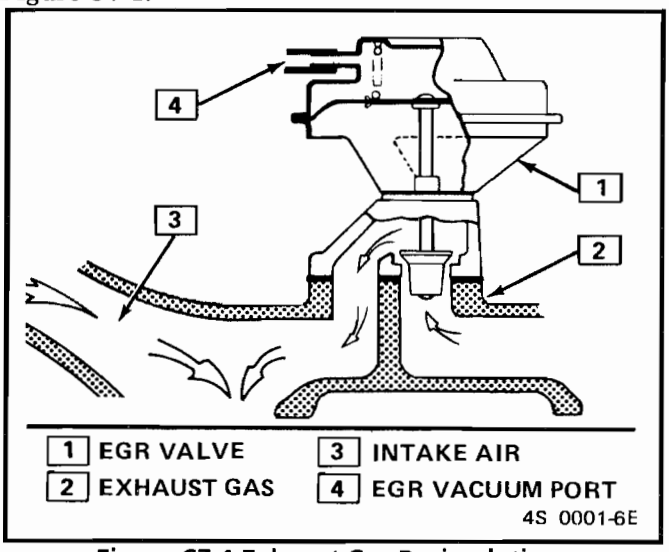


Figure C7-1 Exhaust Gas Recirculation

OPERATION

The EGR valve is opened by ported manifold vacuum to let exhaust gas flow into the intake manifold. The exhaust gas then moves with the air/fuel mixture into the combustion chamber. If too much exhaust gas enters, combustion will not occur. For this reason, very little exhaust gas is allowed to pass through the valve, especially at idle. The EGR valve is usually open, under the following conditions:

- Warm engine operation
- Above idle speed

EGR CONTROL

The EGR vacuum control has a vacuum solenoid that uses "pulse width modulation". This means the ECM turns the solenoid "ON" and "OFF" many times a second and varies the amount of "ON" time ("pulse width") to vary the amount of EGR.

The ECM uses rpm and information from the following sensors to regulate the EGR solenoid:

- Coolant Temperature
- Manifold Air Temperature (MAT)
- Throttle Position (TPS)
- Mass AIR Flow (MAF)
- P / N Switch

This engine is equipped with a temperature switch mounted in the EGR flow tube. This switch is normally open (cold) and closes with heat from exhaust gas, when the EGR is operating. The ECM monitors this switch for proper operation and should set a Code 32, if the system fails.

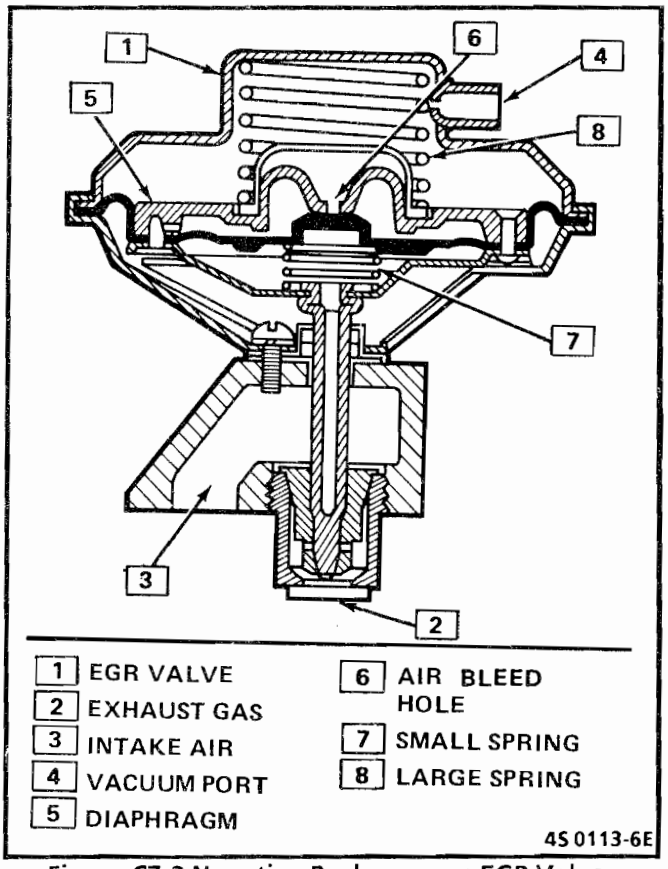
Grounding the ALDL diagnostic "test" terminal, with the ignition "ON" and the engine not running, will energize the solenoid and block vacuum to the EGR valve.

NEGATIVE BACKPRESSURE VALVE

The valve used on this engine is a negative backpressure valve. It varies the amount of exhaust gas flow into the manifold depending on manifold vacuum and variations in exhaust backpressure.

The diaphragm on this valve (shown in Figure C7-2) has an internal vacuum bleed hole which is held closed by a small spring when there is no exhaust backpressure. The amount of vacuum to the valve is controlled by the ECM controlling a solenoid.

Engine vacuum opens the EGR valve against the pressure of a large spring. When manifold vacuum combines with negative exhaust backpressure, the vacuum bleed hole opens and the EGR valve closes.



1 EGR VALVE
2 EXHAUST GAS
3 INTAKE AIR
4 VACUUM PORT
5 DIAPHRAGM
6 AIR BLEED HOLE
7 SMALL SPRING
8 LARGE SPRING

Figure C7-2 Negative Backpressure EGR Valve

EGR VALVE IDENTIFICATION, (Figure C7-3)

- Negative backpressure EGR valves will have an "N" stamped on the top side of the valve after the part number.
- Positive backpressure EGR valves will have a "P" stamped on the top side of the valve, after the part number.
- Port EGR valves have no identification stamped after the part number.

When replacing an EGR valve, always check for correct part number in the parts catalog or supplemental bulletin.

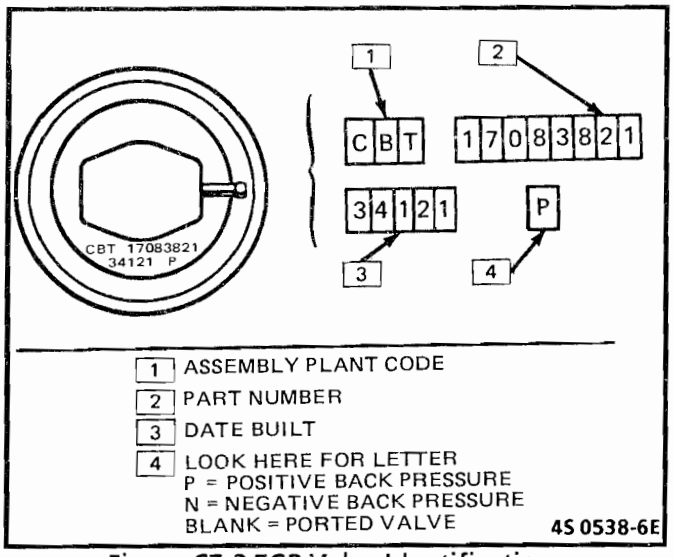
Results of Incorrect EGR System Operation

Too much EGR flow (at idle, cruise, or cold operation) tends to weaken combustion, and may result in any of the following conditions:

- Engine stops after cold start.
- Engine stops at idle after deceleration.
- Car surges during cruise.
- Rough idle.

Too little or no EGR flow allows combustion temperatures to get too high during acceleration and load conditions. This could cause:

- Spark knock (detonation).
- Engine overheating.
- Emission test failure.



1 ASSEMBLY PLANT CODE
2 PART NUMBER
3 DATE BUILT
4 LOOK HERE FOR LETTER
P = POSITIVE BACK PRESSURE
N = NEGATIVE BACK PRESSURE
BLANK = PORTED VALVE

Figure C7-3 EGR Valve Identification

DIAGNOSIS

Diagnosis of the EGR system is covered in CHART C-7 at the end of this section, if Code 32 was not set.

ON-CAR SERVICE

EGR VALVE

Remove or Disconnect

1. Plenum (See Plenum R & R).
2. Vacuum line.
3. Retaining Bolts.
4. EGR valve.

Inspect

If EGR passages in the inlet manifold indicate excessive build-up of deposits, the passages should be cleaned. Care should be taken to ensure that all loose particles are completely removed to prevent them from clogging the EGR valve or from being ingested into the engine.

EGR Manifold Passage

Clean

1. With a wire wheel, buff the exhaust deposits from the mounting surface and around the valve.
2. Look for exhaust deposits in the valve outlet. Remove deposit build-up with a screwdriver.
3. Clean mounting surfaces of intake manifold and valve assembly.

Install or Connect

1. EGR valve on intake manifold using new gasket.
2. Bolts and tighten to 22 N•m (16 ft.lbs.).
3. Vacuum hose to valve.
4. Plenum.

EGR CONTROL SOLENOID

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector at solenoid .
3. Vacuum hoses.
4. Nut and solenoid.

Install or Connect

1. Solenoid and bracket. Tighten nut to 24 N•m (17 ft. lbs.).
2. Vacuum hoses.
3. Electrical connector.
4. Negative battery cable.

PARTS INFORMATION

PARTS NAME	GROUP
Valve, EGR (1)	3.670
Gasket, EGR Valve (15)	3.680
Solenoid, EGR cont Vlv Rly(14)	3.670
Switch, EGR Vlv Temp Ind.	3.670

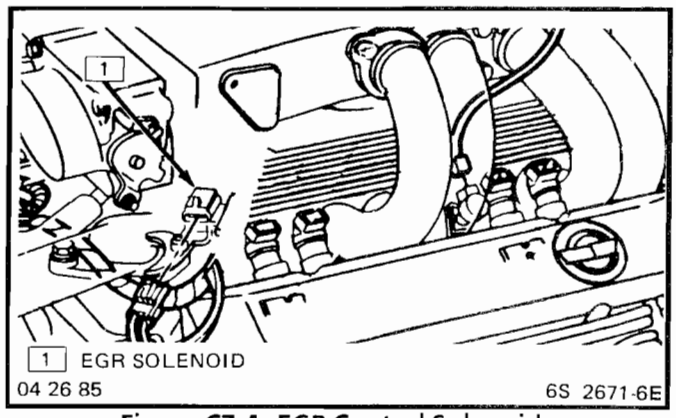


Figure C7-4 EGR Control Solenoid

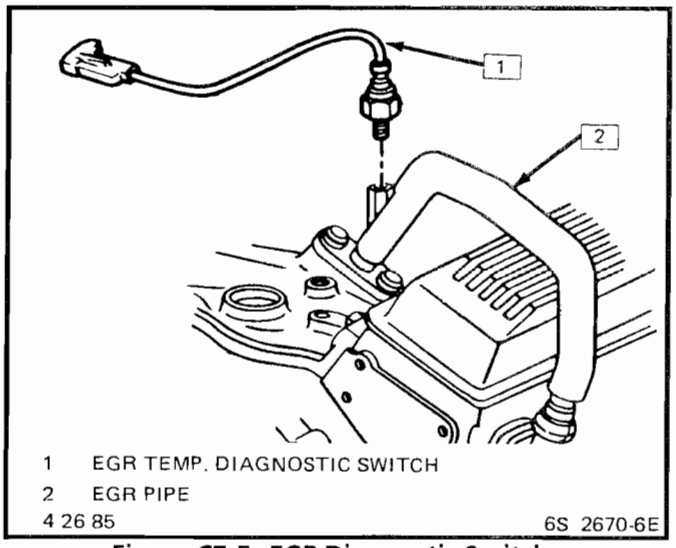


Figure C7-5 EGR Diagnostic Switch

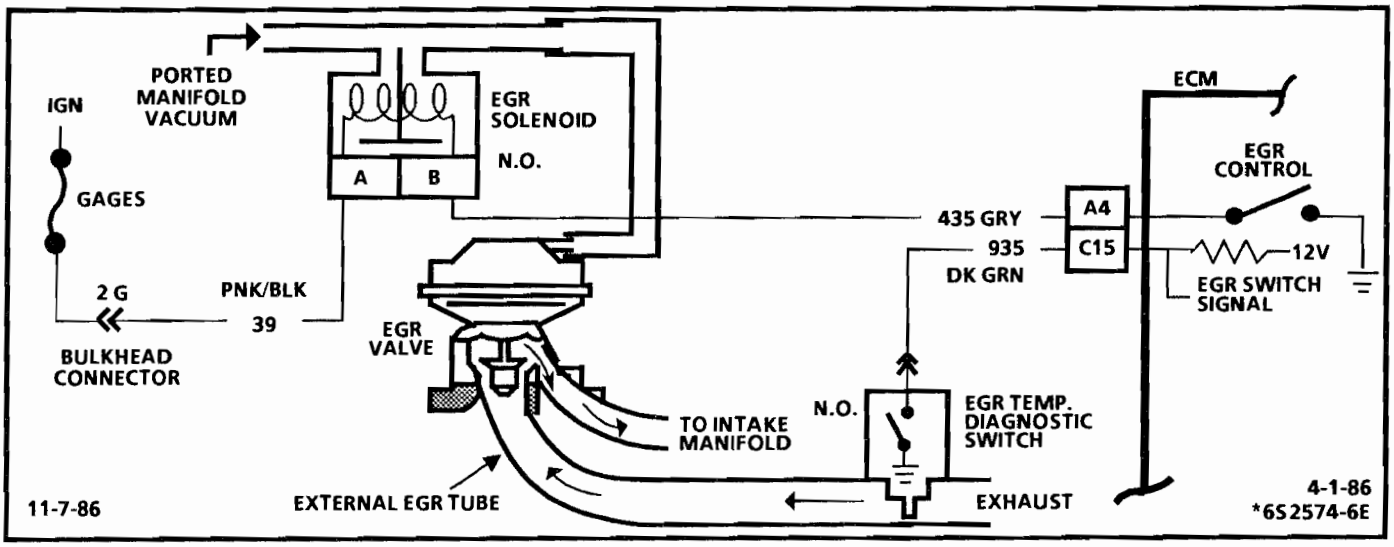


CHART C-7

EXHAUST GAS RECIRCULATION CHECK
5.7L "Y" SERIES (PORT)

Circuit Description:

The Exhaust Gas Recirculation (EGR) valve is controlled by a normally open pulse width modulated (PWM) solenoid. The ECM turns the solenoid "OFF", to allow vacuum to pass to the EGR, and turns the solenoid "ON" to prohibit EGR operation. When EGR is commanded, the solenoid is turned "ON" and "OFF" many times a second (duty cycle).

The duty cycle is calculated by the ECM based on information from the coolant, MAT, TPS, and MAF sensors. Also, engine rpms and the P/N switch input affect EGR. There should be no EGR when in park or neutral, TPS below a calibrated value, or TPS indicating WOT.

With the ignition "ON" and engine stopped, the EGR solenoid is de-energized. The solenoid, however, should be energized, if the diagnostic terminal is grounded with the ignition "ON" and engine not running.

Test Description: The step numbers refer to the step numbers on the diagnostic chart.

1. This will test the solenoid value to determine if it is capable of closing off the manifold vacuum from the EGR valve. The vacuum may bleed off slowly, but this should not be considered a fault.
2. As soon as back pressure is available at the EGR valve, the bleed portion in the valve should open and cause the valve to go to its seated position.
3. The EGR will be inoperative if the P/N switch is misadjusted or faulty. Use "Scan" tool and check P/N switch. Refer to Chart C-1A.

BEFORE USING THIS CHART, CHECK FOR PORTED VACUUM TO EGR SOLENOID, ALSO CHECK HOSES FOR LEAKS OR RESTRICTIONS. SHOULD BE AT LEAST 7" HG VACUUM AT 2000 RPM. THIS CHART ASSUMES THERE IS NO CODE 32.

CHART C-7

EXHAUST GAS RECIRCULATION CHECK 5.7L "Y" SERIES (PORT)

(1)
- IGNITION "ON" ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL.
- DISCONNECT EGR SOLENOID VACUUM HARNESS.
- APPLY 10" VACUUM TO MANIFOLD SIDE OF SOLENOID.
- SHOULD BE ABLE TO HOLD VACUUM.

OK

- UNGROUND DIAGNOSTIC TERMINAL
- VACUUM SHOULD DROP

DROPS

- IGN. 'OFF'
- CONNECT A VACUUM PUMP TO EGR VALVE.
- USING A MIRROR OBSERVE EGR DIAPHRAGM WHILE APPLYING VACUUM
- DIAPHRAGM SHOULD MOVE FREELY AND HOLD VACUUM FOR AT LEAST 20 SECONDS.

OK

(2)
- APPLY VACUUM TO EGR VALVE.
- START ENGINE AND IMMEDIATELY OBSERVE VACUUM
- VALVE IS GOOD IF VALVE MOVES TO SEATED POSITION (VALVE CLOSED) AND VACUUM DROPPED WHILE STARTING ENGINE.

(3) **OK**

A/T CHECK P/N SWITCH

IF OK THERE IS NO TROUBLE FOUND.

NOT OK

- REMOVE EGR VALVE CHECK PASSAGES FOR BEING PLUGGED.
- IF NOT PLUGGED REPLACE EGR VALVE.

NOT OK

REPLACE EGR VALVE.

NO DROP

- DISCONNECT SOLENOID ELECTRICAL CONNECTOR
- NOTE VACUUM

NO DROP

REPLACE SOLENOID

DROPS

CKT 435 SHORTED TO GROUND OR FAULTY ECM

NOT OK

- DISCONNECT EGR SOLENOID ELECTRICAL CONNECTOR.
- CONNECT A TEST LIGHT BETWEEN HARNESS TERMINALS

LIGHT 'ON'

REPLACE SOLENOID.

LIGHT 'OFF'

PROBE EACH HARNESS CONNECTOR TERMINAL WITH A TEST LIGHT CONNECTED TO GROUND.

NO LIGHT

REPAIR OPEN CKT 39.

LIGHT ON 'ONE' (CKT 39)

OPEN CKT 435, CKT 435 SHORTED TO VOLTAGE OR FAULTY ECM.

LIGHT ON BOTH

REPAIR SHORT TO VOLTAGE IN CKT 435

CLEAR CODES AND CONFIRM "CLOSED LOOP " OPERATION AND NO "SERVICE ENGINE SOON" LIGHT .

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SECTION C8

TRANSMISSION CONVERTER CLUTCH (TCC) SYSTEM (A/T) AND AUTOMATIC OVERDRIVE (M/T)

CONTENTS

GENERAL DESCRIPTION C8-1
PURPOSE C8-1
OPERATION C8-1
MANUAL TRANSMISSION C8-2
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Purpose C8-2
DIAGNOSIS C8-2
ON-CAR SERVICE C8-2
SPEED SENSOR C8-2
Automatic Transmission Overdrive Switch Adjustment C8-2
Internal Trans. Components C8-3
M/T Overdrive Relay C8-3
PARTS INFORMATION C8-3

GENERAL DESCRIPTION

PURPOSE

The Transmission Converter Clutch (TCC) System uses a solenoid operated valve in the automatic transmission to couple the engine flywheel to the output shaft of the transmission through the torque converter. This reduces the slippage losses in the converter, which increases fuel economy.

OPERATION

For the converter clutch to apply, two conditions must be met:

- Internal transmission fluid pressure must be correct. For information on internal transmission operation, see Section "7A". This section will cover only the electrical operation of the TCC system.
- The ECM grounds a switch internally to turn on the TCC solenoid in the transmission. This will allow the converter clutch to apply, if the hydraulic pressure is correct, as described above.

The ECM controls the TCC apply solenoid by looking at several sensors:

- Speedo Buffer Sensor (also called Vehicle Speed Sensor (VSS). Speed must be above a certain value before the clutch can apply.

  The Corvette has a Vehicle Speed Sensor mounted in the transmission, for two purposes. First, it replaces the conventional speedometer driven gear and cable assembly, and provides an electrical signal to the instrument panel to operate the electronic speedometer and odometer. See Section "8B" for further information. Second, it supplies vehicle speed information to the ECM via the IP cluster to operate the TCC system.

  The Speedo Buffer Sensor, also called a Vehicle Speed Sensor or VSS, is actually a small PM (Permanent Magnet) generator. It uses a gear, driven by the transmission, to generate voltage pulses at a rate of 4000 pulses per mile. The electronic speedometer then converts this information to miles per hour and sends a signal to the ECM.
- Coolant Temperature Sensor. Engine must be warmed up before clutch can apply.
- Throttle Position Sensor (TPS). After the converter clutch applies, the ECM uses the information from the TPS to release the clutch when the car is accelerating or decelerating at a certain rate.
- Gear Switch. A 4th gear switch is used to tell the ECM that the transmission is in 4th gear. The ECM uses this information to vary the conditions under which the clutch applies or releases in 4th gear only. The transmission need not be in 4th gear to apply the clutch.
- The brake switch is also part of the TCC circuit as it will remove battery voltage to the TCC solenoid when the brake pedal is depressed.

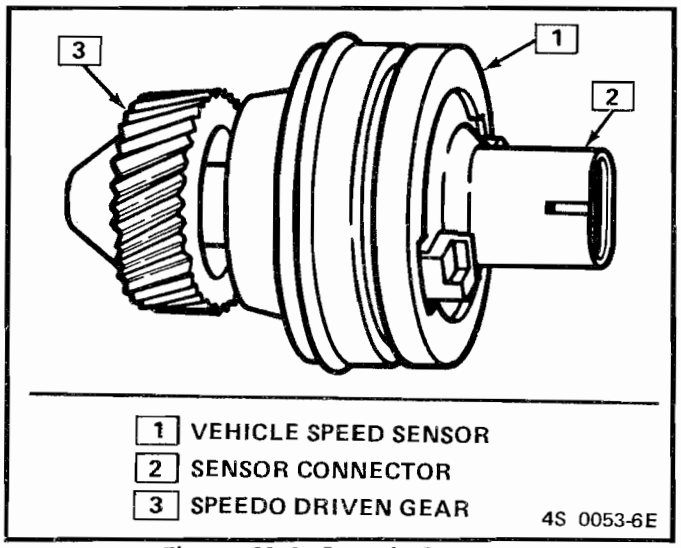


Figure C8-1 Speedo Sensor

- Overdrive Switch. An Automatic Transmission Overdrive Switch (mounted in the console) is used to tell the ECM that the transmission is in overdrive. The ECM uses this information to vary the conditions under which the clutch applies or

releases. The transmission does not have to be in overdrive to apply the clutch.

If the converter clutch does not apply, fuel economy may be lower than expected. If the Vehicle Speed Sensor fails, the TCC will not apply. If the 4th gear Switch does not operate, the TCC may not engage or disengage at the right time.

MANUAL TRANSMISSION

The Automatic overdrive used with a manual transmission is used to improve fuel economy and provide better shift pattern control.

The overdrive used in the manual transmission is controlled by the ECM, when selected by the driver. The driver controls the overdrive with a button on the shifter knob, which activates a switch at the base of the shifter. When the correct conditions are met to allow overdrive, the overdrive can be engaged or disengaged each time the button is pushed and released.

The ECM uses engine temperature, rpm, VSS, TPS, and the MAF sensor signal to determine when to allow overdrive. There is also an oil pressure switch in the transmission, which prohibits the overdrive solenoid from being activated until there is sufficient oil pressure to activate overdrive.

By monitoring the engine parameters, and the 1st gear switch, the ECM can determine what gear the vehicle is in. This will cause the ECM to keep the overdrive relay de-energized, if the vehicle is in 1st gear except during deceleration. If WOT is detected while in 2nd or 3rd gear, the ECM will de-energize the relay and keep the relay de-energized until 4th gear is selected or until the overdrive button is again pushed. If the ECM detects WOT while in 4th gear and overdrive was selected, the overdrive will be disabled, but the ECM will energize the relay when WOT is no longer being detected.

When the ECM commands the overdrive relay "ON", the information is sent to the instrument panel via the serial data line, which causes the overdrive indicator light to turn "ON". The overdrive light will be "ON" only when the ECM has commanded the overdrive "ON". System description on how the ECM controls the overdrive and for diagnosing the system refer to CHART C-8B.

SHIFT LIGHT

Purpose

The shift light is incorporated into the digital cluster to indicate to the driver when a higher gear should be selected. This informs the driver that the transmission should be shifted to obtain better fuel economy.

The ECM computes what gear the vehicle is in by monitoring Engine rpm and vehicle speed. When the ECM determines a higher gear ratio can be selected, the information is sent to the Digital cluster by way of the serial data line. The circuitry in the cluster then takes the serial data information and controls the shift light. The digital cluster also uses information on the serial data line from the ECM to calculate instant average miles per gallon fuel range and to turn "ON" the overdrive light on a manual transmission.

DIAGNOSIS

TCC system diagnosis is covered in CHART C-8A. The TCC will not operate without VSS, so if the ECM detects a problem in the VSS system, a Code 24 should set. In this case see CODE 24 CHART.

The diagnosis of the manual transmission overdrive is covered in CHART C-8B.

The instant average MPG indicator and the information needed by the I. P. to turn "ON" the shift light comes from the ECM, via the serial data line. If both functions are inoperative, the serial data information may not be reaching the I. P. Also, when a "Scan" tool is plugged into the ALDL connector, the serial data to the I. P. will be disabled.

See Section "8A" for I. P. diagnosis.

ON-CAR SERVICE

SPEED SENSOR

Remove or Disconnect

1. Negative battery cable.
2. Raise car on hoist.
3. Electrical connector (5).
   to sensor (1).
4. Bolt and Retainer (9).
5. Sensor (1), oil seal (7), and speedo driven gear (3) from transmission.
6. Speedo driven gear from sensor.

Install or Connect

1. Oil seal (7) on sensor (1). Coat with transmission fluid before installing.
2. Speedo driven gear (3) on sensor (1).
3. Sensor and gear assembly into transmission. Make sure sensor is fully seated.
4. Spacer (8), Retainer (9), and bolt. Torque bolt to 5N•m (3.5 lb.-ft.).
5. Electrical connector.
6. Lower car.
7. Negative battery cable

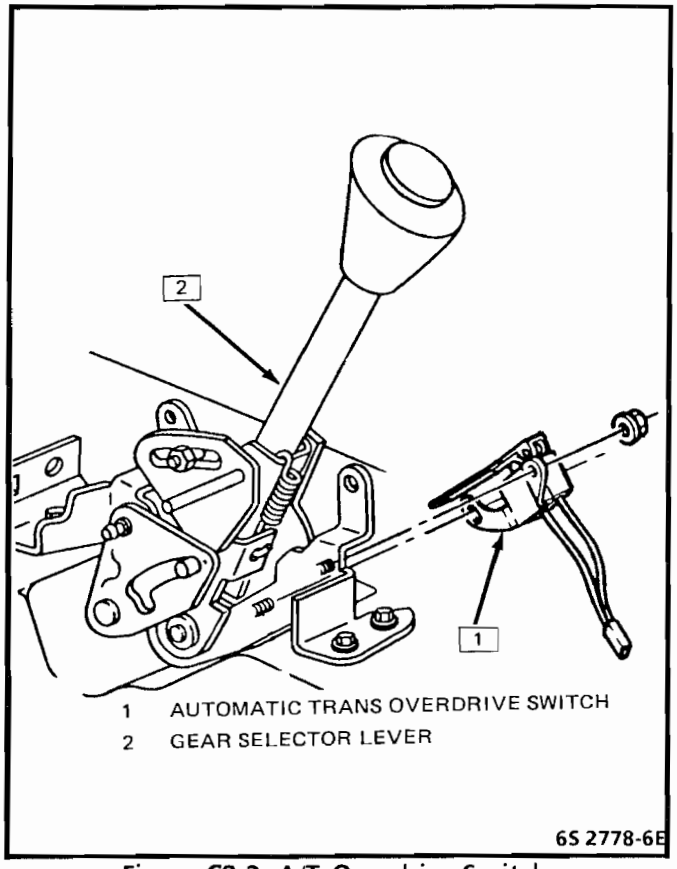


Figure C8-2 A/T Overdrive Switch

Automatic Transmission Overdrive Switch Adjustment (Figure C8-2)

1. Set transmission selector lever midway between Drive & Overdrive.
2. Adjust switch until contacts just close (0 ohms).

Internal Trans. Components

For replacement of internal switches or solenoid, refer to the appropriate Section "7".

M/T Overdrive Relay

Refer to Fig. 3 for location of the overdrive relay.

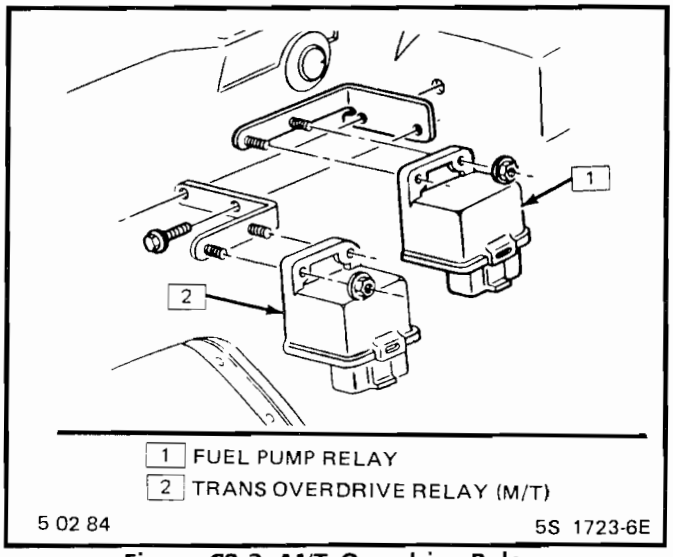


Figure C8-3 M/T Overdrive Relay

PARTS INFORMATION

PART NAME	GROUP
Sensor, Speedo Buffer (1)	9.761
Spacer. Speedo Sem)8)	9.761
Retainer, Speedo Sen (9)	9.761
Switch, Trans Overdrive	4.115

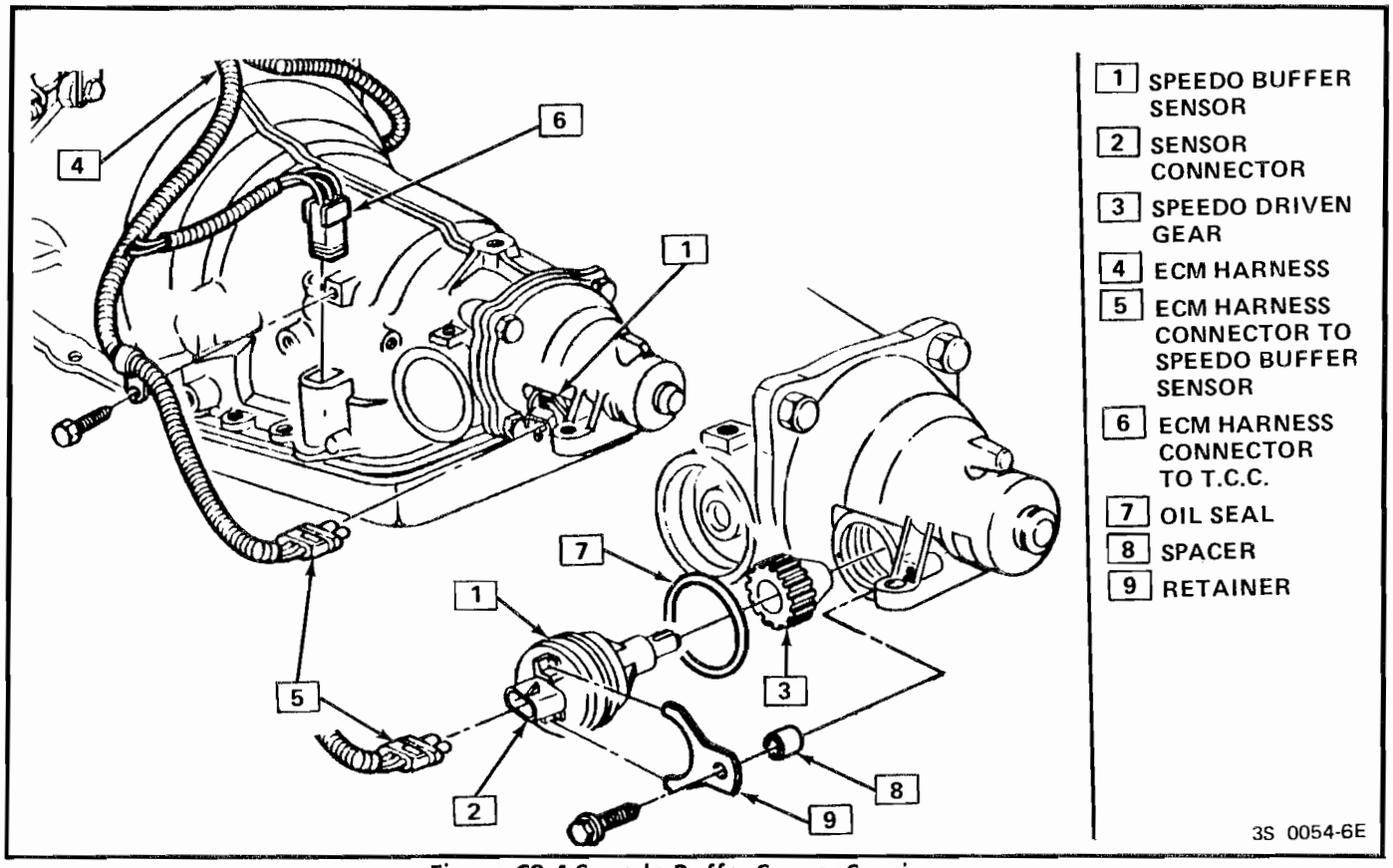


Figure C8-4 Speedo Buffer Sensor Service

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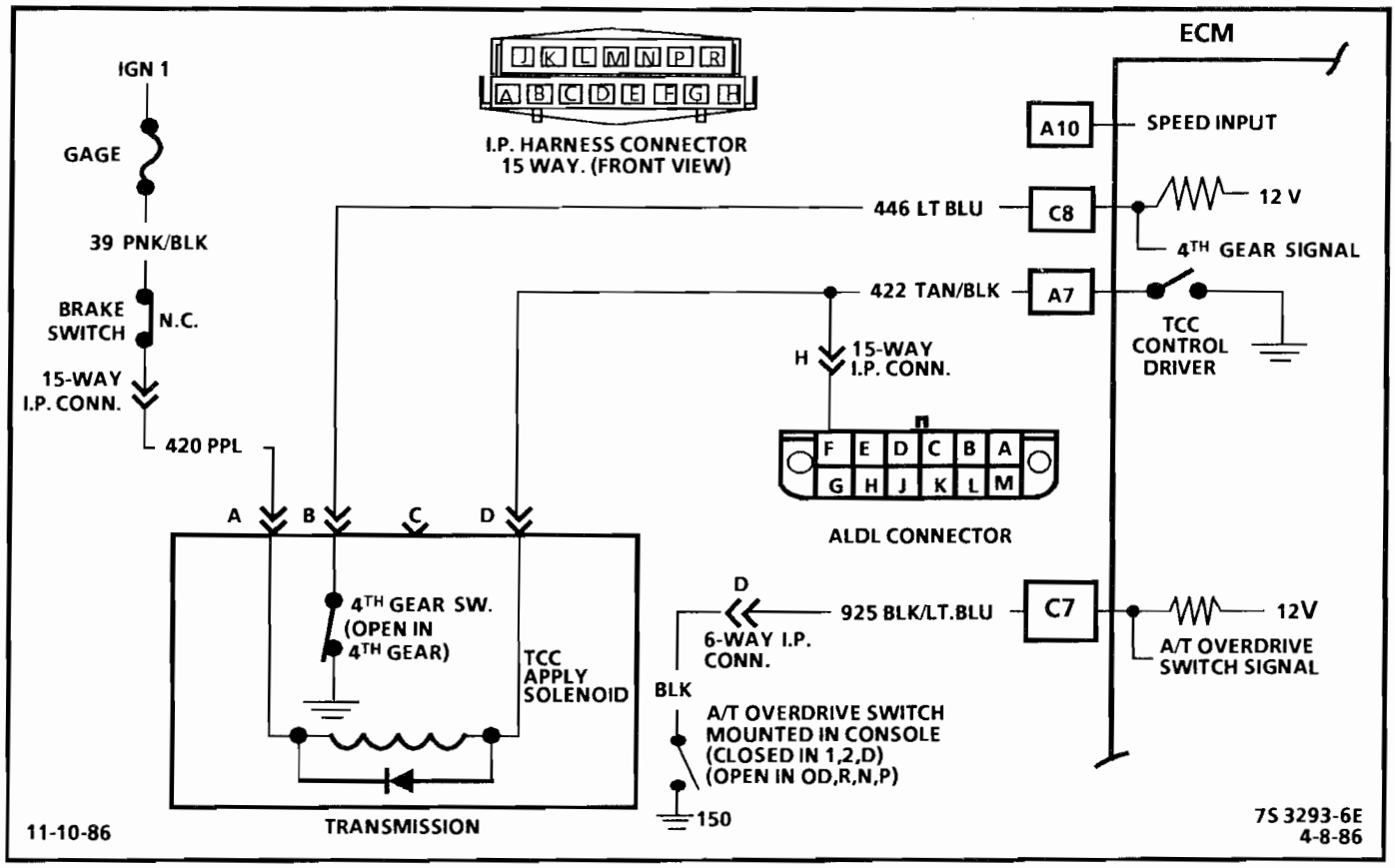


CHART C-8A (Page 1 of 2)

AUTOMATIC TRANSMISSION CONVERTER CLUTCH (TCC) ELECTRICAL DIAGNOSIS 5.7L "Y" SERIES (PORT)

Circuit Description:

The purpose of the automatic transmission torque converter clutch feature is to eliminate the power loss of the torque converter stage, when the vehicle is in a cruise condition. This allows the convenience of the automatic transmission and the fuel economy of a manual transmission. The heart of the system is a solenoid, located inside the automatic transmission, which is controlled by the ECM.

When the solenoid coil is activated ("ON"), the torque converter clutch is applied, which results in straight through mechanical coupling from the engine to transmission. When the transmission solenoid is deactivated, the torque converter clutch is released which allows the torque converter to operate in the conventional manner (fluidic coupling between engine and transmission).

The ECM turns "ON" the TCC when coolant temp. is above 65° C (149° F), TPS not changing ,and vehicle speed above a specified value. For TCC lock-up speed and function of the gear switches, refer to circuit description on the facing page of CHART C-8A (Page 2 of 2).

Test Description:

Step numbers refer to step numbers on diagnostic chart.

1. When a test light is connected from ALDL terminal "F" to ground, a test light "ON" indicates battery voltage is OK and the TCC solenoid is disengaged.
2. When the diagnostic terminal is grounded, the ECM should energize the TCC solenoid and the test light should go out.

Diagnostic Aids:

A "Scan" tool only indicates when the ECM has turned "ON" the TCC driver (grounded CKT 422) but this does not confirm that the TCC has engaged. To determine if the TCC is functioning properly, engine rpm should decrease when the "Scan" indicates the TCC driver has turned "ON". To determine if the gear switches are functioning properly, perform the checks in CHART C-8A (Page 2 of 2). The switches will not prevent the TCC from functioning, but will affect TCC lock and unlock points.

CHART C-8A

(Page 1 of 2)

TRANSMISSION CONVERTER CLUTCH (TCC) ELECTRICAL DIAGNOSIS 5.7L "Y" SERIES (PORT)

- USING A "SCAN" TOOL CHECK THE FOLLOWING AND CORRECT IF NECESSARY.
- COOLANT TEMPERATURE SHOULD BE ABOVE 65°C.
- TPS - BE SURE TPS SIGNAL IS NOT ERRATIC.
- VSS - BE SURE "SCAN" DISPLAYS VSS WITH DRIVE WHEELS TURNING. IF CODE 24 IS PRESENT, SEE CODE CHART 24.

(1)

- MECHANICAL CHECKS, SUCH AS LINKAGE, OIL LEVEL, ETC. SHOULD BE PERFORMED PRIOR TO USING THIS CHART.
- IGN. "ON".
- CONNECT TEST LIGHT TO ALDL CONNECTOR TERMINAL "F" AND GROUND.
- BULB SHOULD "LIGHT."

DOES IT?

YES

- DEPRESS BRAKE PEDAL.
- LIGHT SHOULD GO OUT.

DOES IT?

YES

(2)

- IGN. "ON", ENGINE "OFF."
- RELEASE BRAKE PEDAL.
- GROUND DIAG. TERMINAL.
- LIGHT SHOULD GO OUT.

DOES IT?

YES

TCC CIRCUIT OK. BE SURE VEHICLE IS EQUIPPED WITH THE CORRECT MEM-CAL. TO CHECK 4TH GEAR SWITCH AND O.D. SWITCH, SEE CHART C-8A (2 OF 2).

NO

OPEN CKT 422 OR FAULTY ECM.

NO

BRAKE SWITCH OUT OF ADJUSTMENT OR FAULTY, OR CKT 422 SHORTED TO VOLTAGE.

NO

- DISCONNECT TCC ELECTRICAL CONNECTOR.
- CONNECT TEST LIGHT BETWEEN TERM. "A & D".
- BULB SHOULD NOT "LIGHT."

DOES IT?

NO

- CONNECT TEST LIGHT FROM TERM. "A" TO GROUND.
- BULB SHOULD "LIGHT."

DOES IT?

YES

- GROUND ALDL TERM. "F".
- WITH TEST LIGHT CONNECTED BETWEEN TRANS. CONNECTOR TERMINALS "A & D".
- THE BULB SHOULD "LIGHT"

DOES IT?

YES

FAULTY TCC CONNECTION OR TCC SOLENOID.

NO

REPAIR OPEN CKT BETWEEN TRANS. & ALDL TERM. "F"

NO

OPEN IN CKT 39, TCC BRAKE SWITCH CKT, OR ADJUST SWITCH.

YES

CKT 422 SHORTED TO GROUND OR FAULTY ECM.

7S 3325
4-7-86

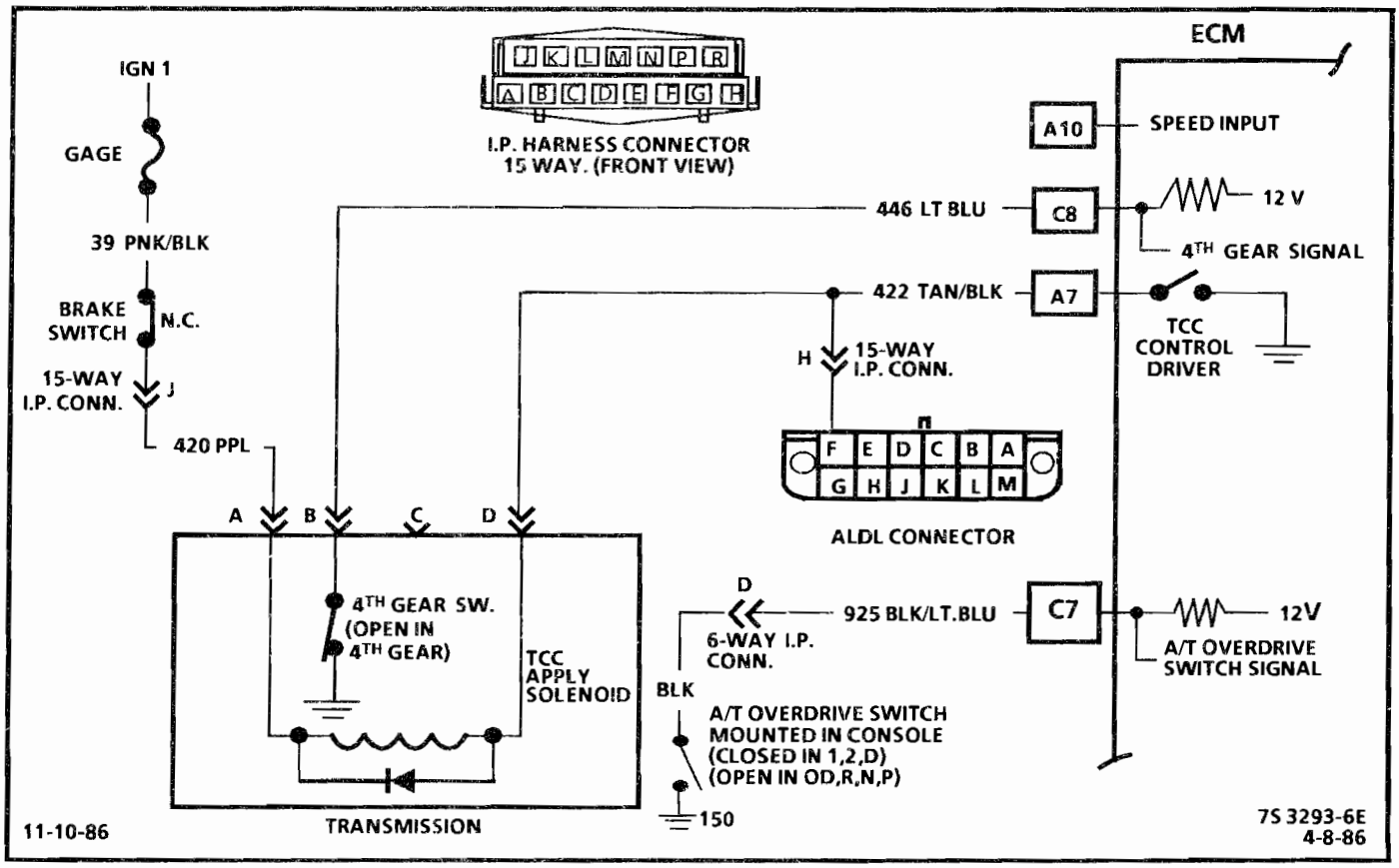


CHART C-8A (Page 2 of 2)

TRANSMISSION CONVERTER CLUTCH (TCC) ELECTRICAL DIAGNOSIS 5.7L"Y " SERIES (PORT)

Circuit Description:

The overdrive switch (mounted in tlie console) is used to modify TCC engagement speeds. The TCC will engage, on a warm engine, under a given road load, in 2nd, 3rd, and 4th gear at about 30 mph, if the gear selector is in overdrive (OD). If 2nd or drive (D) range is selected, the overdrive switch should be closed and the ECM will not engage TCC until vehicle speed reaches about 40 mph. This switch will help eliminate the TCC from engaging and disengaging while in city traffic.

A 4th gear switch (mounted in the trans.) opens when the trans. shifts into 4th gear, and this switch is used by the ECM to modify TCC lock and unlock points, when in a 4-3 downshift maneuver.

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. With the gear shifter in overdrive, the "Scan" should display "YES". In this position, TCC will engage at about 30 mph.
2. CKT 925 can be checked for continuity by measuring for the 12 volt signal from the ECM with a DVOM. If the 12 volts is present, the switch is misadjusted or faulty.
3. This step should cause the switch to close and the "Scan" should display "NO".
4. Unless the switch or CKT 446 is open, the "Scan" should display "NO", indicating the transmission is not in 4th gear. The 4th gear switch should only be open while in 4th gear.
5. This step determines if the ECM and wiring are OK. Grounding CKT 446 should cause the "Scan" to display "NO", indicating the transmission is not in 4th gear.
6. Checks the operation of the 4th gear switch. When the transmission shifts into 4th gear, the switch should open and the "Scan" should display "YES"
7. Disconnecting the TCC connector simulates an open switch, to determine if CKT 446 is shorted to ground or the problem is in the transmission.

Diagnostic Aids:

A road test may be necessary to verify the customer complaint. If the "Scan" indicates TCC is turning "ON" and "OFF" erratically, check the state of the 4th gear switch and the overdrive switch to be sure they're not changing states under a steady throttle position. If the swiches are changing states, check connections and wire routing carefully.

CHART C-8A

(Page 2 of 2)

TRANSMISSION CONVERTER CLUTCH (TCC) ELECTRICAL DIAGNOSIS 5.7L "Y" SERIES (PORT)

CHECKS MADE ON THIS PAGE WILL NOT PREVENT THE TCC FROM WORKING, BUT WILL AFFECT ENGAGEMENT OR DISENGAGEMENT POINTS.

(1) • IGNITION "ON", ENGINE "OFF".
• PLACE SHIFTER IN OVERDRIVE.
DOES "SCAN" INDICATE OVERDRIVE REQUESTED?

YES

(3) • PLACE SHIFTER IN DRIVE RANGE.
DOES "SCAN" INDICATE OVERDRIVE REQUESTED?

NO

(4) • DOES "SCAN" INDICATE TRANS. IS IN 4TH GEAR?

NO

(6) • RAISE DRIVE WHEELS
• SHIFT VEHICLE INTO OVERDRIVE
• INCREASE SPEED SLOWLY UNTIL TRANS. SHIFTS INTO 4TH GEAR.
• DOES "SCAN" INDICATE TRANS. IS IN 4TH GEAR?

YES

4TH GEAR SWITCH OK. REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

NO

(7) • IGNITION "ON" ENGINE "OFF"
• DISCONNECT TRANS. ELECTRICAL CONNECTOR
• DOES "SCAN" INDICATE TRANS. IS IN 4TH GEAR?

YES

WIRE GROUNDED INTERNALLY IN TRANS. OR FAULTY 4TH GEAR SWITCH.

NO

CKT 446 SHORTED TO GROUND OR FAULTY ECM.

NO

(2) CKT 925 SHORTED TO GROUND, OVERDRIVE SWITCH MISADJUSTED OR FAULTY.

YES

CKT 925 OR GROUND CKT OPEN, SWITCH MISADJUSTED OR FAULTY SWITCH.

YES

(5) • DISCONNECT TCC ELECTRICAL CONNECTOR.
• JUMPER HARNESS TERMINAL "B" (CKT 446) TO GROUND.
• DOES "SCAN" INDICATE TRANS. IS IN 4TH GEAR?

NO

FAULTY CONNECTION OR 4TH GEAR SWITCH.

YES

OPEN CKT 446, FAULTY CONNECTION OR FAULTY ECM.

7S 3326
4-8-86

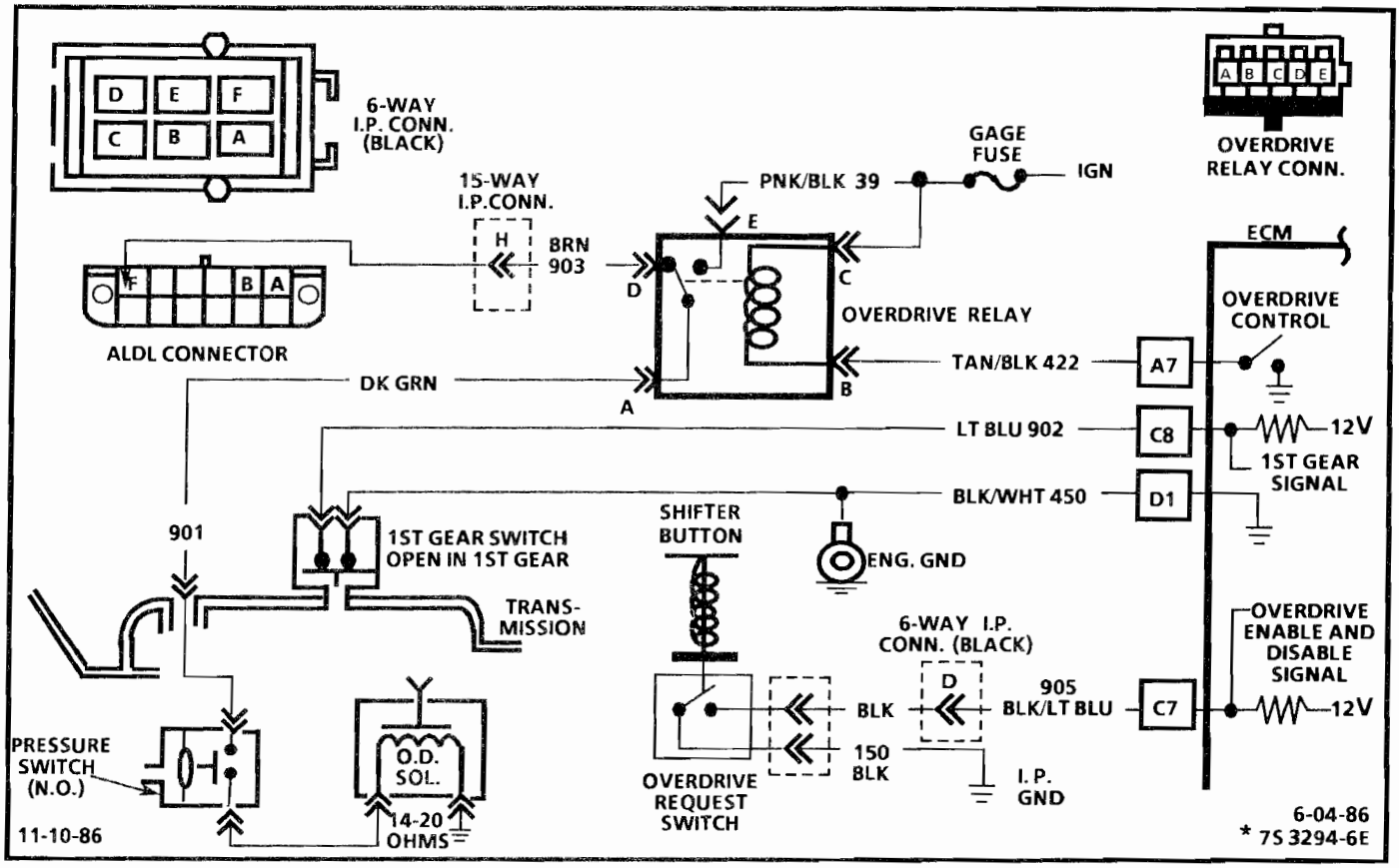


CHART C-8B

(Page 1 of 2)
MANUAL TRANSMISSION (WITH OVERDRIVE) ELECTRICAL DIAGNOSIS
5.7L "Y" SERIES (PORT)

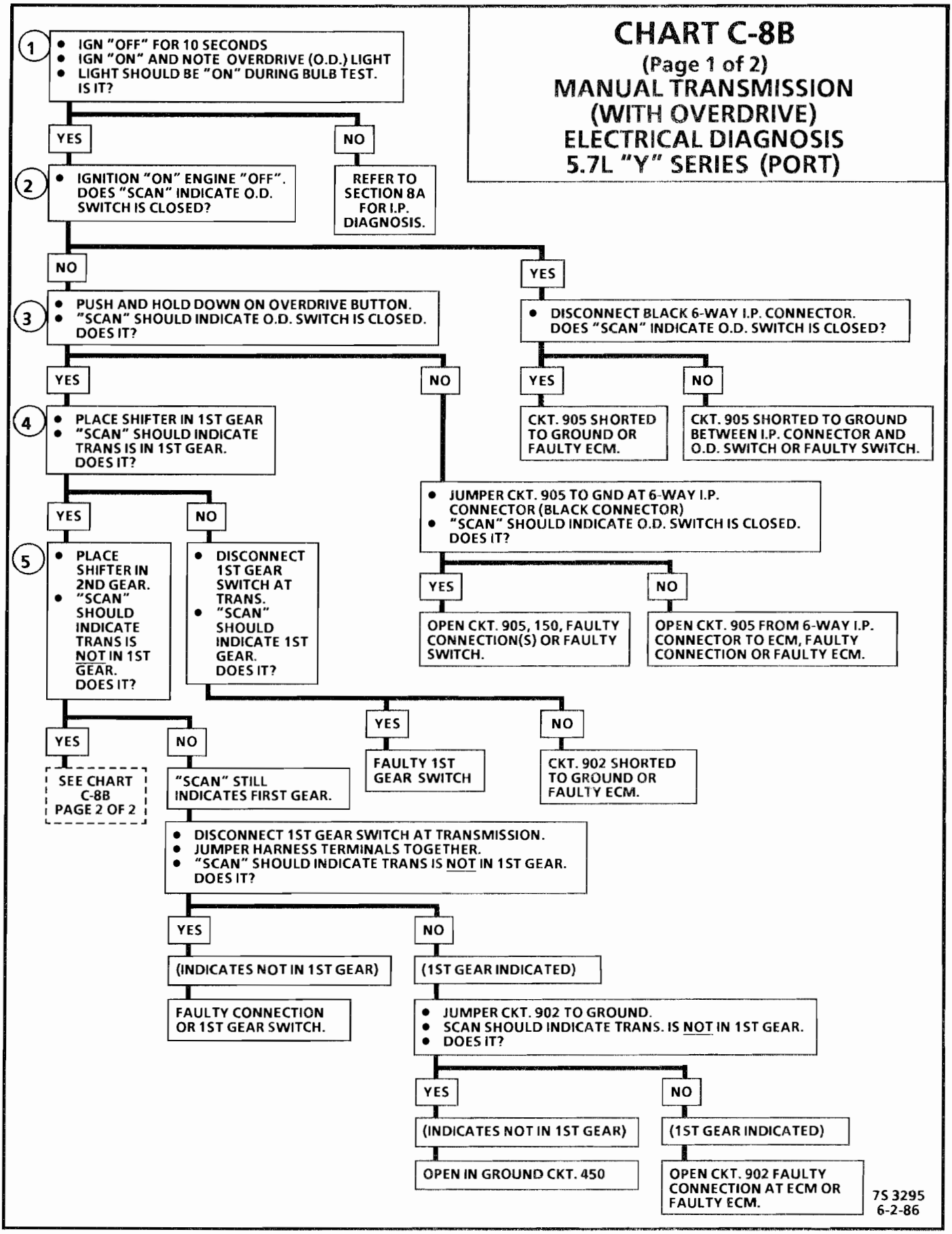
Circuit Description:

The overdrive is activated when the ECM grounds CKT 422, which energizes the overdrive relay. The ECM supplies a current limiting 12 volts on CKT 905 and, when the overdrive button is pushed, the ECM will see 0 volts and each time the button is pushed and released the overdrive will be activated or deactivated, if all the correct parameters are met to allow overdrive. The first gear switch, which is open in first gear, is used to disable overdrive while in first gear, except during a first gear deceleration. The ECM also turns "ON" the overdrive light, located in the I.P., by sending a message via the serial data line. For more information on the controls and description of operation refer to Description of operation, at the front of this Section (C8).

Test Description: Step numbers refer to step numbers on diagnostic chart.

1. The ECM turns "ON" the overdrive light by sending a message to the I.P. via the serial data line. The message is sent to the I.P. whenever the ECM energizes the overdrive relay. The instant miles per gallon and shift light information is also transmitted to the I.P. from the ECM. With a "Scan" tool plugged into the ALDL connector, the serial data information does not get transmitted to the I.P.
2. The ECM will automatically enable overdrive when all the correct parameters are met, even if the overdrive button is not pushed. The "Scan" should display "closed", when the OD button is pushed and held down (switch contacts closed).
3. With the overdrive button pushed down and held, the switch contacts should be closed which should be displayed by the "Scan" as "closed".
4. With the shifter in 1st gear the switch contacts should be open and should be displayed as a "yes" on the "Scan".
5. With the shifter in 2nd, 3rd, or 4th gear, the first gear switch contacts should be closed and should be displayed as a "no" on the 1st gear position of a "Scan" tool.

CHART C-8B
(Page 1 of 2)
MANUAL TRANSMISSION (WITH OVERDRIVE) ELECTRICAL DIAGNOSIS 5.7L "Y" SERIES (PORT)



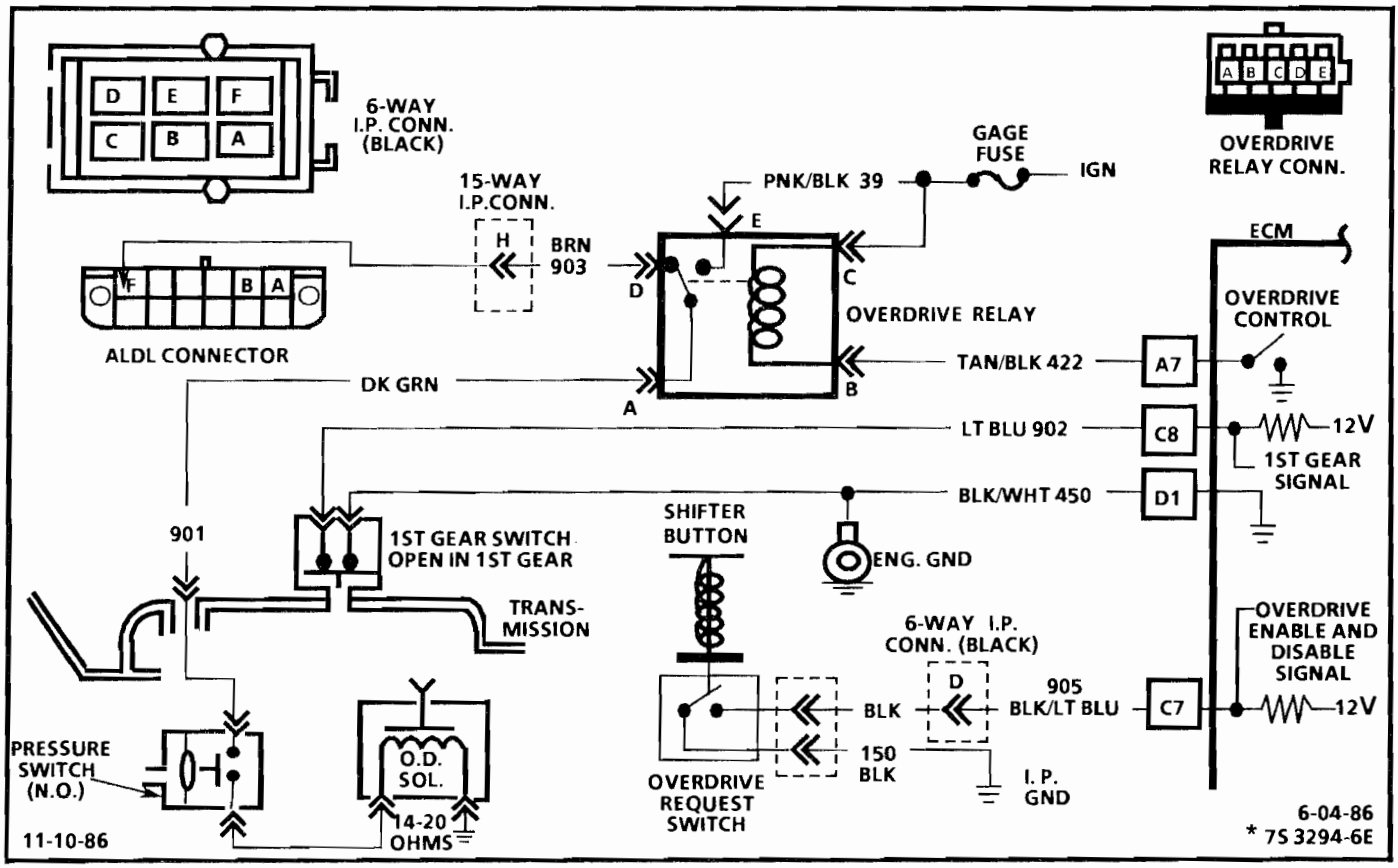
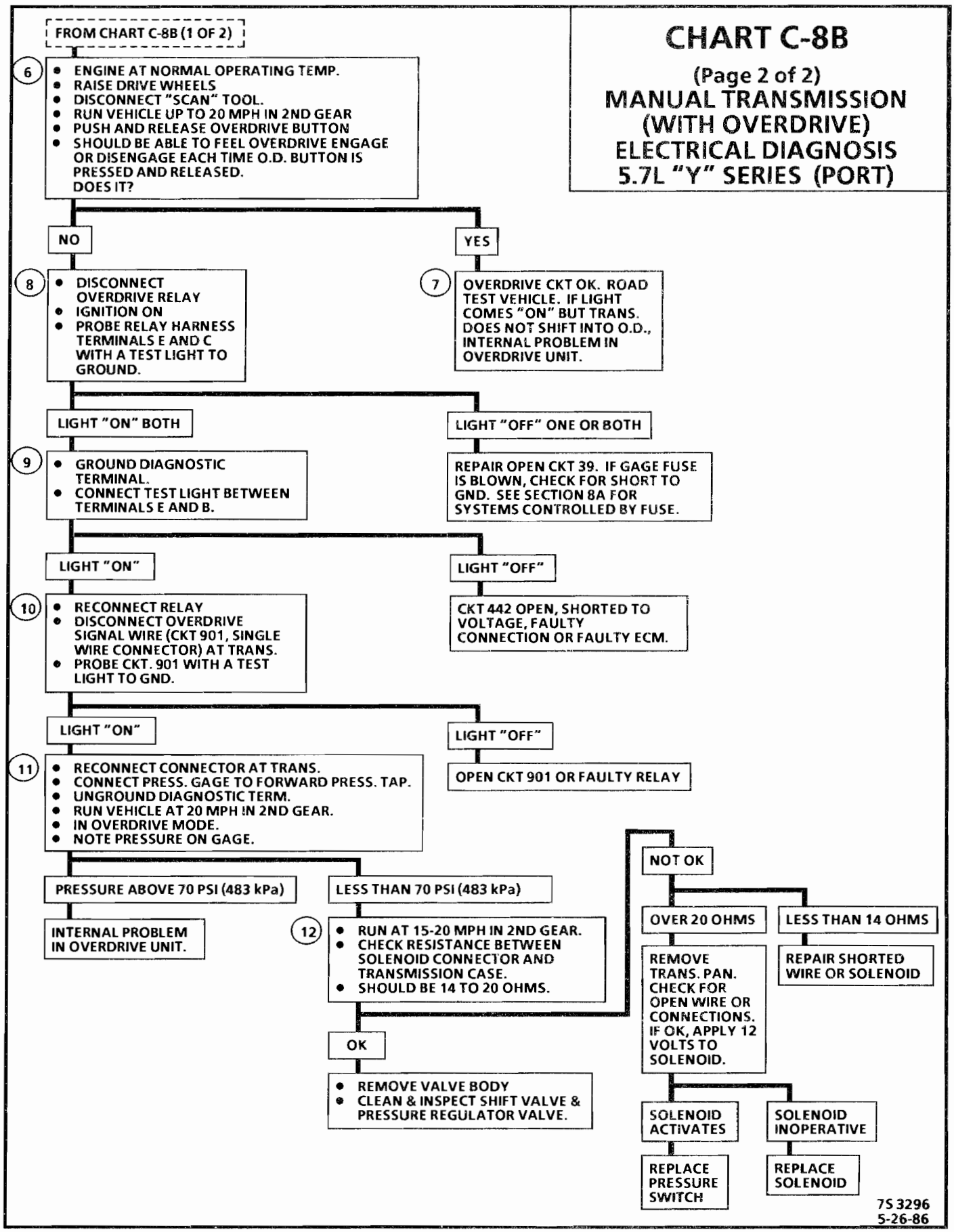


CHART C-8B

(Page 2 of 2)
MANUAL TRANSMISSION (WITH OVERDRIVE)
ELECTRICAL DIAGNOSIS
5.7L "Y" SERIES (PORT)

Test Description: Step numbers refer to step numbers on diagnostic chart.

6. At 20 mph, the oil pressure switch should be closed, which should allow the overdrive solenoid to be energized. This step checks the entire electrical control portion of the overdrive system.
7. The overdrive electrical circuit is OK up to this point, but does not necessarily mean the overdrive is operational under a road load condition. The vehicle should be road tested, if possible, to verify that the internal portion of the overdrive assembly is OK.
8. This step checks for continuity of CKT 39 from the gage fuse. If the fuse is blown, refer to Section "8A" for circuits controlled by the gage fuse.
9. With the ignition "ON" and the diagnostic terminal grounded, the overdrive control driver in the ECM should ground CKT 422. This step checks for the ability of the ECM to ground the relay control circuit.
10. This step checks the overdrive relay and continuity of CKT 901.
11. If the oil pressure switch and overdrive solenoid are both functioning properly, the oil pressure at this point should be above 70 psi (483 kPa). If the correct pressure is available at the pressure tap, but the overdrive is not engaging, there is an internal problem in the overdrive unit. Refer to Section "7B" for installing pressure gage and for diagnosing the internal portion of the overdrive assembly.
12. At 20 mph, the oil pressure siwtch should be closed and complete the circuit to the overdrive solenoid. A normal circuit should measure about 14-20 ohms, at this step.


CHART C-8B
(Page 2 of 2)
MANUAL TRANSMISSION
(WITH OVERDRIVE)
ELECTRICAL DIAGNOSIS
5.7L "Y" SERIES (PORT)
FROM CHART C-8B (1 OF 2)
6
• ENGINE AT NORMAL OPERATING TEMP.
• RAISE DRIVE WHEELS
• DISCONNECT "SCAN" TOOL.
• RUN VEHICLE UP TO 20 MPH IN 2ND GEAR
• PUSH AND RELEASE OVERDRIVE BUTTON
• SHOULD BE ABLE TO FEEL OVERDRIVE ENGAGE OR DISENGAGE EACH TIME O.D. BUTTON IS PRESSED AND RELEASED.
DOES IT?
NO
YES
8
• DISCONNECT OVERDRIVE RELAY
• IGNITION ON
• PROBE RELAY HARNESS TERMINALS E AND C WITH A TEST LIGHT TO GROUND.
7
OVERDRIVE CKT OK. ROAD TEST VEHICLE. IF LIGHT COMES "ON" BUT TRANS. DOES NOT SHIFT INTO O.D., INTERNAL PROBLEM IN OVERDRIVE UNIT.
LIGHT "ON" BOTH
LIGHT "OFF" ONE OR BOTH
9
• GROUND DIAGNOSTIC TERMINAL.
• CONNECT TEST LIGHT BETWEEN TERMINALS E AND B.
REPAIR OPEN CKT 39. IF GAGE FUSE IS BLOWN, CHECK FOR SHORT TO GND. SEE SECTION 8A FOR SYSTEMS CONTROLLED BY FUSE.
LIGHT "ON"
LIGHT "OFF"
10
• RECONNECT RELAY
• DISCONNECT OVERDRIVE SIGNAL WIRE (CKT 901, SINGLE WIRE CONNECTOR) AT TRANS.
• PROBE CKT. 901 WITH A TEST LIGHT TO GND.
CKT 442 OPEN, SHORTED TO VOLTAGE, FAULTY CONNECTION OR FAULTY ECM.
LIGHT "ON"
LIGHT "OFF"
11
• RECONNECT CONNECTOR AT TRANS.
• CONNECT PRESS. GAGE TO FORWARD PRESS. TAP.
• UNGROUND DIAGNOSTIC TERM.
• RUN VEHICLE AT 20 MPH IN 2ND GEAR.
• IN OVERDRIVE MODE.
• NOTE PRESSURE ON GAGE.
OPEN CKT 901 OR FAULTY RELAY
PRESSURE ABOVE 70 PSI (483 kPa)
LESS THAN 70 PSI (483 kPa)
INTERNAL PROBLEM IN OVERDRIVE UNIT.
12
• RUN AT 15-20 MPH IN 2ND GEAR.
• CHECK RESISTANCE BETWEEN SOLENOID CONNECTOR AND TRANSMISSION CASE.
• SHOULD BE 14 TO 20 OHMS.
NOT OK
OK
• REMOVE VALVE BODY
• CLEAN & INSPECT SHIFT VALVE & PRESSURE REGULATOR VALVE.
OVER 20 OHMS
LESS THAN 14 OHMS
REMOVE TRANS. PAN. CHECK FOR OPEN WIRE OR CONNECTIONS. IF OK, APPLY 12 VOLTS TO SOLENOID.
REPAIR SHORTED WIRE OR SOLENOID
SOLENOID ACTIVATES
SOLENOID INOPERATIVE
REPLACE PRESSURE SWITCH
REPLACE SOLENOID
7S 3296
5-26-86

BLANK

SECTION C12

COOLING FAN CONTROL

CONTENTS

GENERAL DESCRIPTION C12-1
OPERATION C12-1
DIAGNOSIS C12-1
ON-CAR SERVICE C12-1
PARTS INFORMATION C12-1

GENERAL DESCRIPTION

The fan is used for engine and A/C condenser cooling, but the fan only operates under certain conditions.

OPERATION

The electric cooling fan on this engine is controlled by the ECM. The ECM will ground the cooling fan relay, which turns on the fan, when the following conditions are met.

- Coolant temperature sensor signal indicating a temperature greater than 108°C (226°F).
  Or: A/C head pressure greater than 233 psi (1606 kPa).
  And vehicle speed less than 35 mph.
  When the cooling fan is turned "ON", the ECM will keep it "ON" for a minimum time of 15 seconds.

DIAGNOSIS

The following C-12 charts will diagnose the ECM controlled cooling fan.

ON-CAR SERVICE

Cooling system component replacement can be found in Section "6B".

PARTS INFORMATION

PART NAME	GROUP
Fan, Engine	1.055
Motor, Fan	1.055
Relay, Engine Fan	1.055

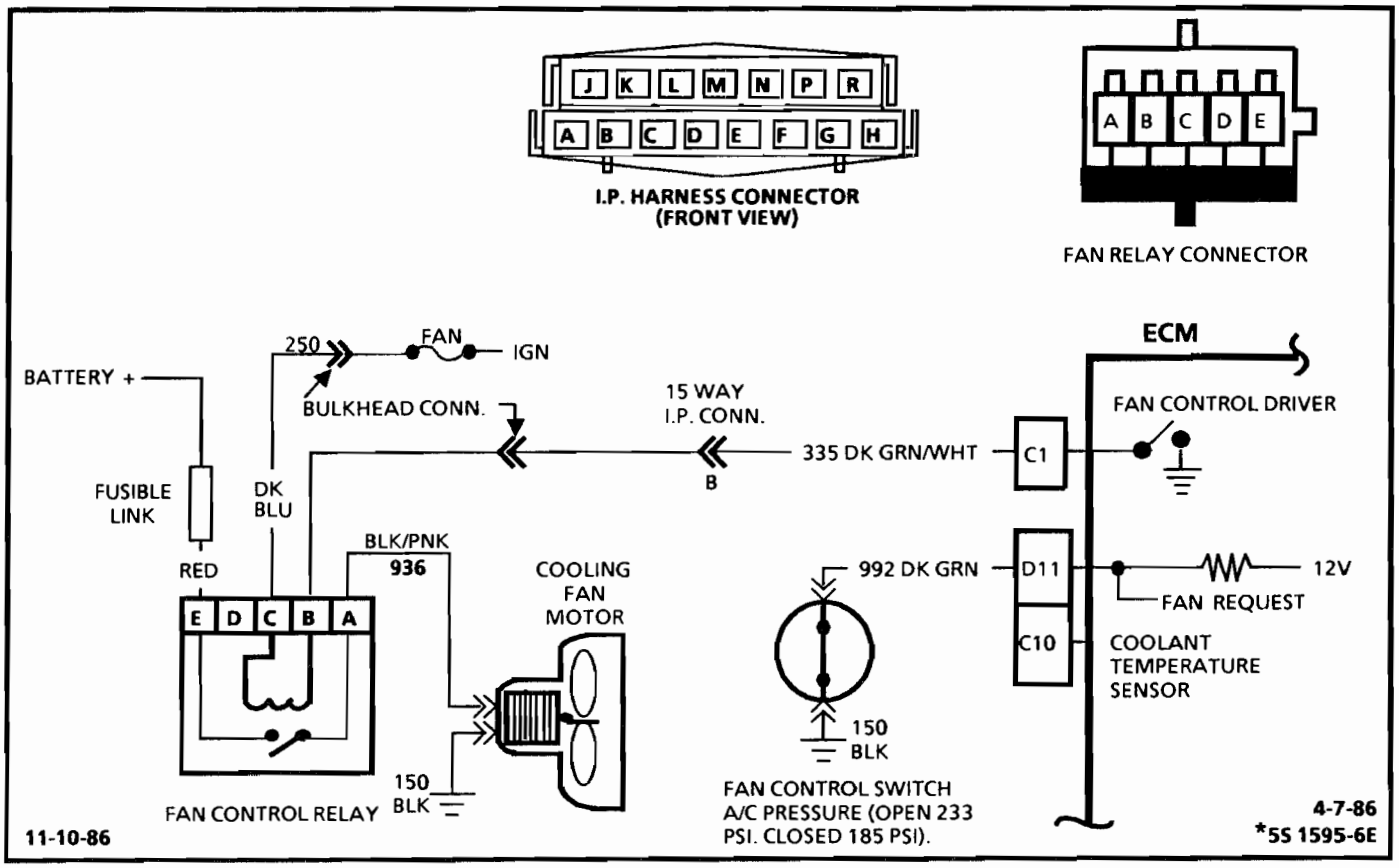


CHART C-12

(Page 1 of 2)
COOLING FAN CONTROL CIRCUIT DIAGNOSIS
5.7L "Y" SERIES (PORT)

Circuit Description:

- The cooling fan is totally controlled by the ECM, based on inputs from the coolant sensor and fan control switch. The fan should run if coolant temperature is greater than 108°C (226°F).
- Battery voltage is supplied to the fan relay on terminal "E" and ignition voltage to terminal "C".
- Grounding CKT 335 (relay terminal "B") will energize the relay and supply battery voltage to the fan motor. Once the fan relay is energized by the ECM, it will remain "ON" for a minimum of 15 seconds.
- The ECM will remove the ground to CKT 335, if vehicle speed is over 35 MPH, unless the engine is overheating.
- The fan control switch, mounted in the A/C High pressure line, will open when head pressure exceeds 233 psi (1600 kPa) and this input causes the ECM to ground CKT 335.
- If a Code 14 or 15 sets, or the ECM is operating in the fuel back-up mode, the ECM will turn "ON" the cooling fan.

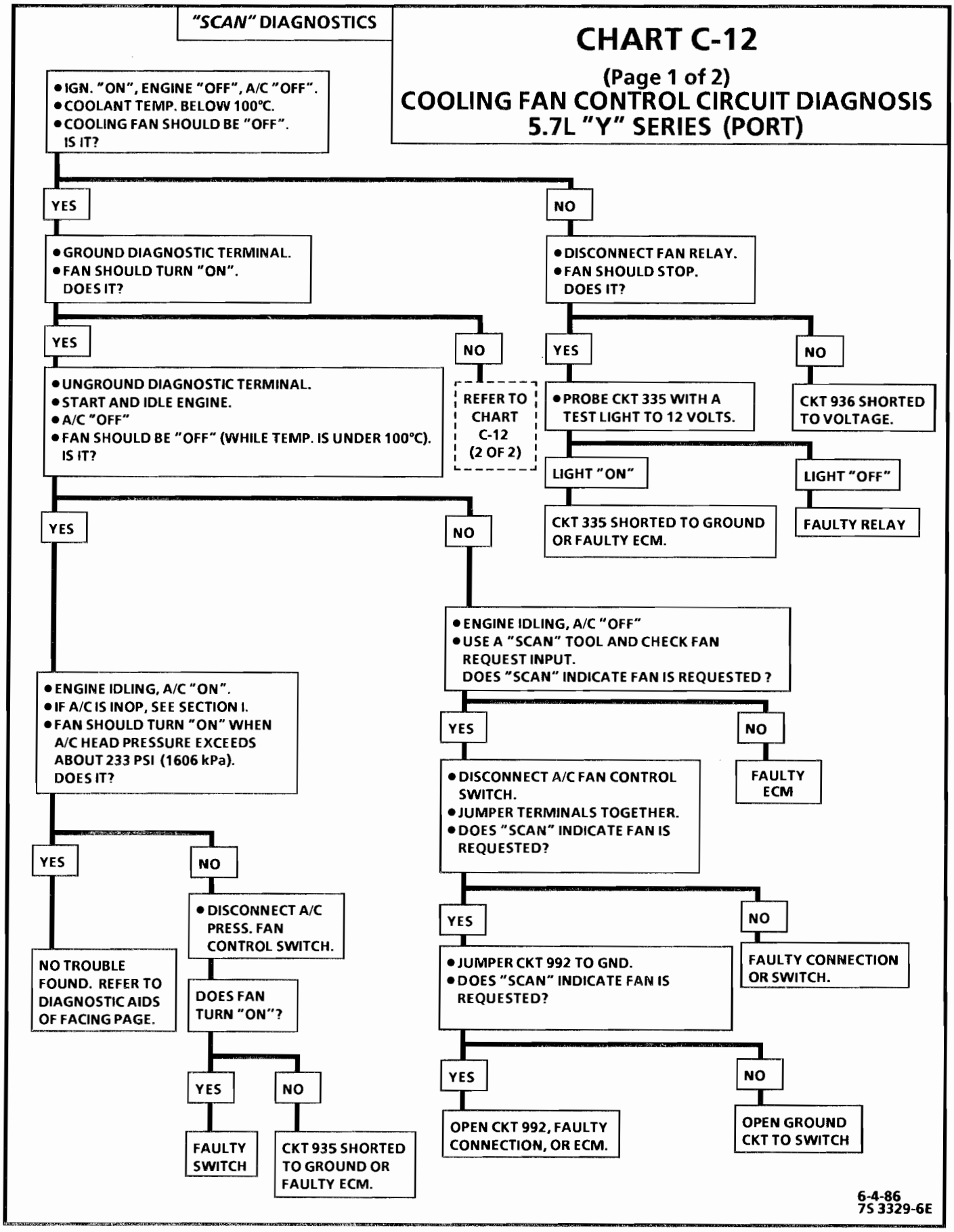
Diagnostic Aids:

If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boil over, or the hot light, or temp. gage indicated overheating.

If the gage or light indicates overheating, but no boilover is detected, the gage circuit should be checked. The gage accuracy can also be checked by comparing the coolant sensor reading using a "Scan" tool and comparing its reading with the gage reading.

If the engine is actually overheating and the gage indicates overheating, but the cooling fan is not coming "ON", the coolant sensor has probably shifted out of calibration and should be replaced.

If the engine is overheating and the cooling fan is "ON", the cooling system should be checked.


"SCAN" DIAGNOSTICS
CHART C-12
(Page 1 of 2)
COOLING FAN CONTROL CIRCUIT DIAGNOSIS
5.7L "Y" SERIES (PORT)
• IGN. "ON", ENGINE "OFF", A/C "OFF".
• COOLANT TEMP. BELOW 100°C.
• COOLING FAN SHOULD BE "OFF".
IS IT?
YES
NO
• GROUND DIAGNOSTIC TERMINAL.
• FAN SHOULD TURN "ON".
DOES IT?
• DISCONNECT FAN RELAY.
• FAN SHOULD STOP.
DOES IT?
YES
NO
YES
NO
• UNGROUND DIAGNOSTIC TERMINAL.
• START AND IDLE ENGINE.
• A/C "OFF"
• FAN SHOULD BE "OFF" (WHILE TEMP. IS UNDER 100°C).
IS IT?
REFER TO CHART C-12 (2 OF 2)
• PROBE CKT 335 WITH A TEST LIGHT TO 12 VOLTS.
CKT 936 SHORTED TO VOLTAGE.
LIGHT "ON"
LIGHT "OFF"
CKT 335 SHORTED TO GROUND OR FAULTY ECM.
FAULTY RELAY
YES
NO
• ENGINE IDLING, A/C "OFF"
• USE A "SCAN" TOOL AND CHECK FAN REQUEST INPUT.
DOES "SCAN" INDICATE FAN IS REQUESTED ?
• ENGINE IDLING, A/C "ON".
• IF A/C IS INOP, SEE SECTION I.
• FAN SHOULD TURN "ON" WHEN A/C HEAD PRESSURE EXCEEDS ABOUT 233 PSI (1606 kPa).
DOES IT?
YES
NO
FAULTY ECM
• DISCONNECT A/C FAN CONTROL SWITCH.
• JUMPER TERMINALS TOGETHER.
• DOES "SCAN" INDICATE FAN IS REQUESTED?
YES
NO
• DISCONNECT A/C PRESS. FAN CONTROL SWITCH.
NO TROUBLE FOUND. REFER TO DIAGNOSTIC AIDS OF FACING PAGE.
DOES FAN TURN "ON"?
• JUMPER CKT 992 TO GND.
• DOES "SCAN" INDICATE FAN IS REQUESTED?
FAULTY CONNECTION OR SWITCH.
YES
NO
YES
NO
FAULTY SWITCH
CKT 935 SHORTED TO GROUND OR FAULTY ECM.
OPEN CKT 992, FAULTY CONNECTION, OR ECM.
OPEN GROUND CKT TO SWITCH
6-4-86
7S 3329-6E

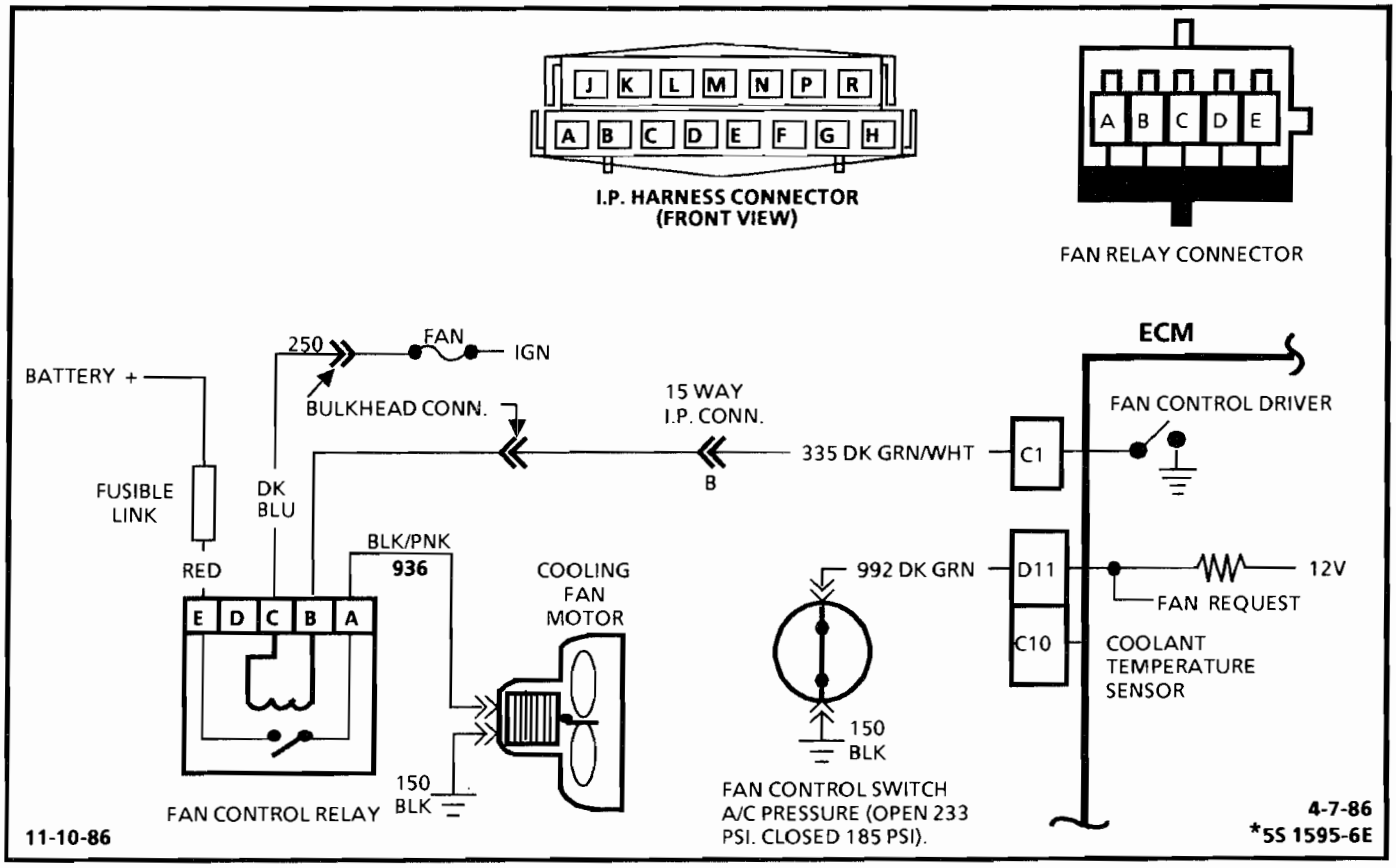


CHART C-12

(Page 2 of 2)
COOLING FAN CONTROL CIRCUIT DIAGNOSIS
5.7L "Y" SERIES (PORT)

Circuit Description:

- The cooling fan is totally controlled by the ECM, based on inputs from the coolant sensor and fan control switch. The fan should run if coolant temperature is greater than 108°C (226°F).
  - Battery voltage is supplied to the fan relay on terminal "E" and ignition voltage to terminal "C".
  - Grounding CKT 335 (relay terminal "B") will energize the relay and supply battery voltage to the fan motor. Once the fan relay is energized by the ECM, it will remain "ON" for a minimum of 15 seconds.
  - The ECM will remove the ground to CKT 335, if vehicle speed is over 35 MPH, unless the engine is overheating.
  - The fan control switch, mounted in the A/C High pressure line, will open when head pressure exceeds 233 psi (1600 kPa) and this input causes the ECM to ground CKT 335.
  - If a Code 14 or 15 sets, or the ECM is operating in the fuel back-up mode, the ECM will turn "ON" the cooling fan.

Diagnostic Aids:

If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boil over or the hot light or temp. gage indicated overheating.

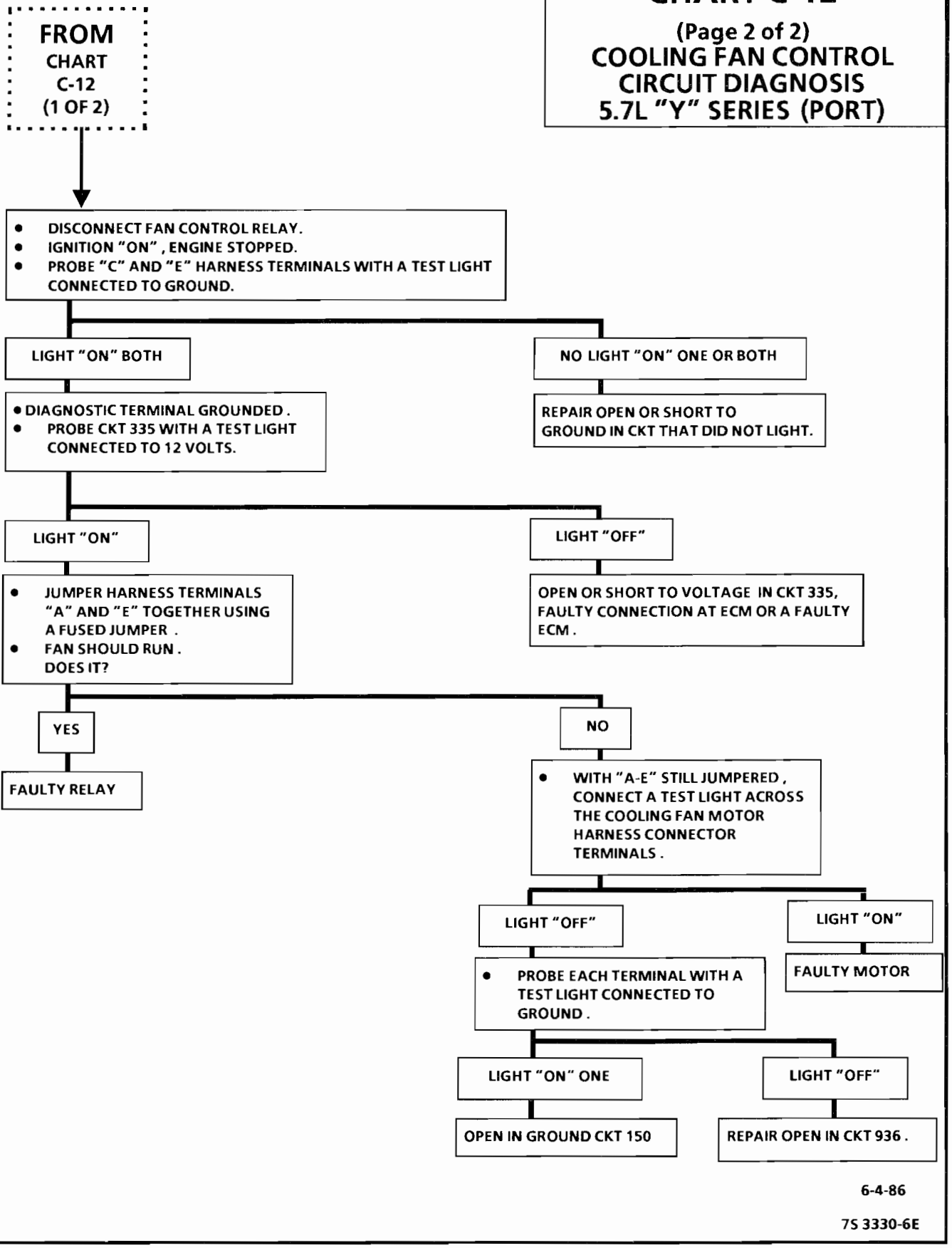
If the gage or light indicates overheating, but no boilover is detected, the gage circuit should be checked. The gage accuracy can also be checked by comparing the coolant sensor reading using a "Scan" tool and comparing its reading with the gage reading.

If the engine is actually overheating and the gage indicates overheating, but the cooling fan is not coming "ON", the coolant sensor has probably shifted out of calibration and should be replaced.

If the engine is overheating and the cooling fan is "ON", the cooling system should be checked.

CHART C-12

(Page 2 of 2)
COOLING FAN CONTROL CIRCUIT DIAGNOSIS
5.7L "Y" SERIES (PORT)



6-4-86

7S 3330-6E

BLANK

SECTION C13

POSITIVE CRANKCASE VENTILATION (PCV)

CONTENTS

GENERAL DESCRIPTION C13-1
Results of Incorrect Operation C13-1
DIAGNOSIS C13-1
FUNCTIONAL CHECK OF PCV VALVE C13-1
ON-CAR SERVICE C13-2
PARTS INFORMATION C13-2

GENERAL DESCRIPTION

A "closed" Crankcase Ventilation (PCV) system is used to provide more complete scavenging of crankcase vapors. Fresh air from the air cleaner is supplied to the crankcase, mixed with blow-by gases and, then, passed through a positive crankcase ventilation (PCV) valve into the intake manifold (Figure C13-1).

The primary control is through the PCV valve (Figure C13-2) which meters the flow at a rate depending on manifold vacuum.

To maintain idle quality, the PCV valve restricts the flow when intake manifold vacuum is high. If abnormal operating conditions arise, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase vent tube into the engine air inlet to be consumed by normal combustion.

Results of Incorrect Operation

A plugged valve or hose may cause:

- Rough idle.
- Stalling or slow idle speed.
- Oil leaks.
- Sludge in engine.

A leaking valve or hose would cause:

- Rough idle.
- Stalling.
- High idle speed.

DIAGNOSIS

FUNCTIONAL CHECK OF PCV VALVE

If an engine is idling rough, check for a clogged PCV valve or plugged hose. Replace as required. Use the following procedure:

1. Remove PCV valve from rocker arm cover.
2. Run the engine at idle.
3. Place your thumb over end of valve to check for vacuum. If there is no vacuum at valve, check for plugged hoses or manifold port, or PCV valve. Replace plugged or deteriorated hoses.
4. Turn "OFF" the engine and remove PCV valve. Shake valve and listen for the rattle of check needle inside the valve. If valve does not rattle, replace valve.

With this system, any blow-by in excess of the system capacity (from a badly-worn engine, sustained heavy load, etc.) is exhausted into the air cleaner and is drawn into the engine.

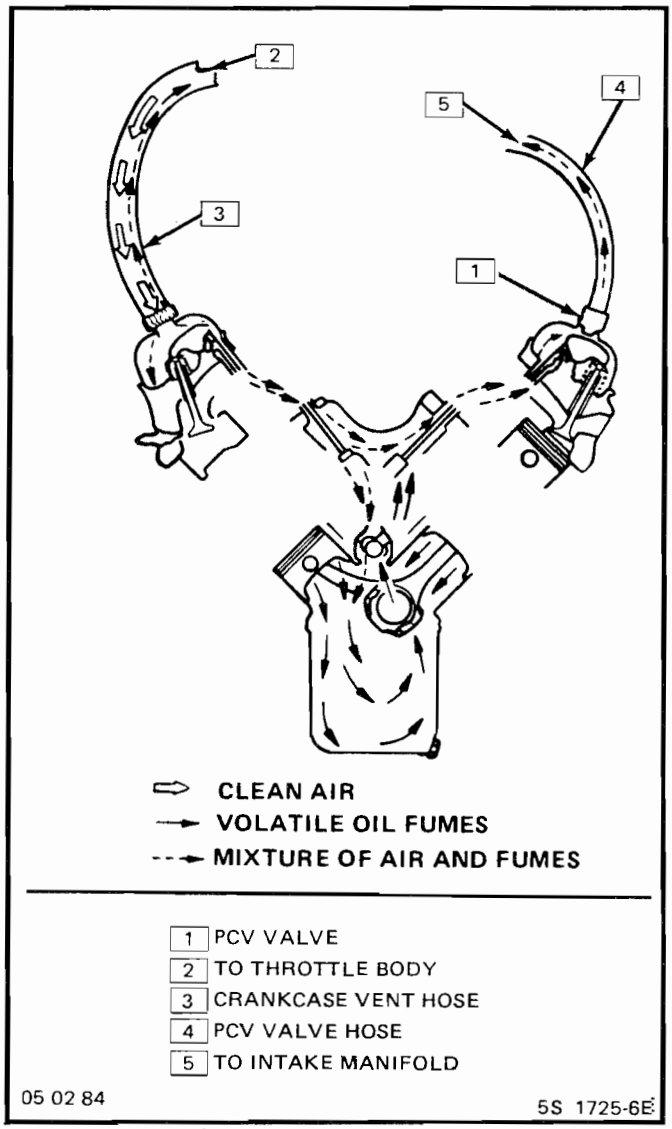


Figure C13-1 PCV Flow

Proper operation of the PCV System is dependent upon a sealed engine. If oil sludging or dilution is noted, and the PCV System is functioning properly, check engine for possible cause and correct to ensure that system will function as intended.

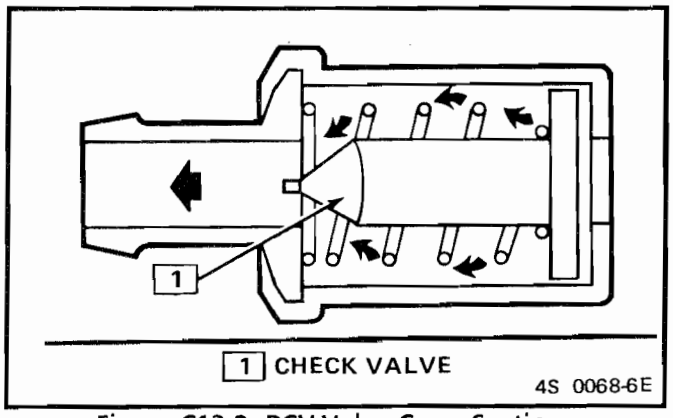


Figure C13-2 PCV Valve Cross Section

PARTS INFORMATION

PART NAME	GROUP
Air Cleaner	3.402
Valve Asm, C/Case Vent	1.745
Tube, C/Case Vent	1.762
Hose, C/Case Vent V1v	1.762
Breather, A/C and Sil	3.410

ON-CAR SERVICE

An engine which is operated without any crankcase ventilation can be damaged. Therefore, it is important to replace the PCV valve at intervals shown in Section 0B.

Periodically, inspect the hoses and clamps and replace any showing signs of deterioration.

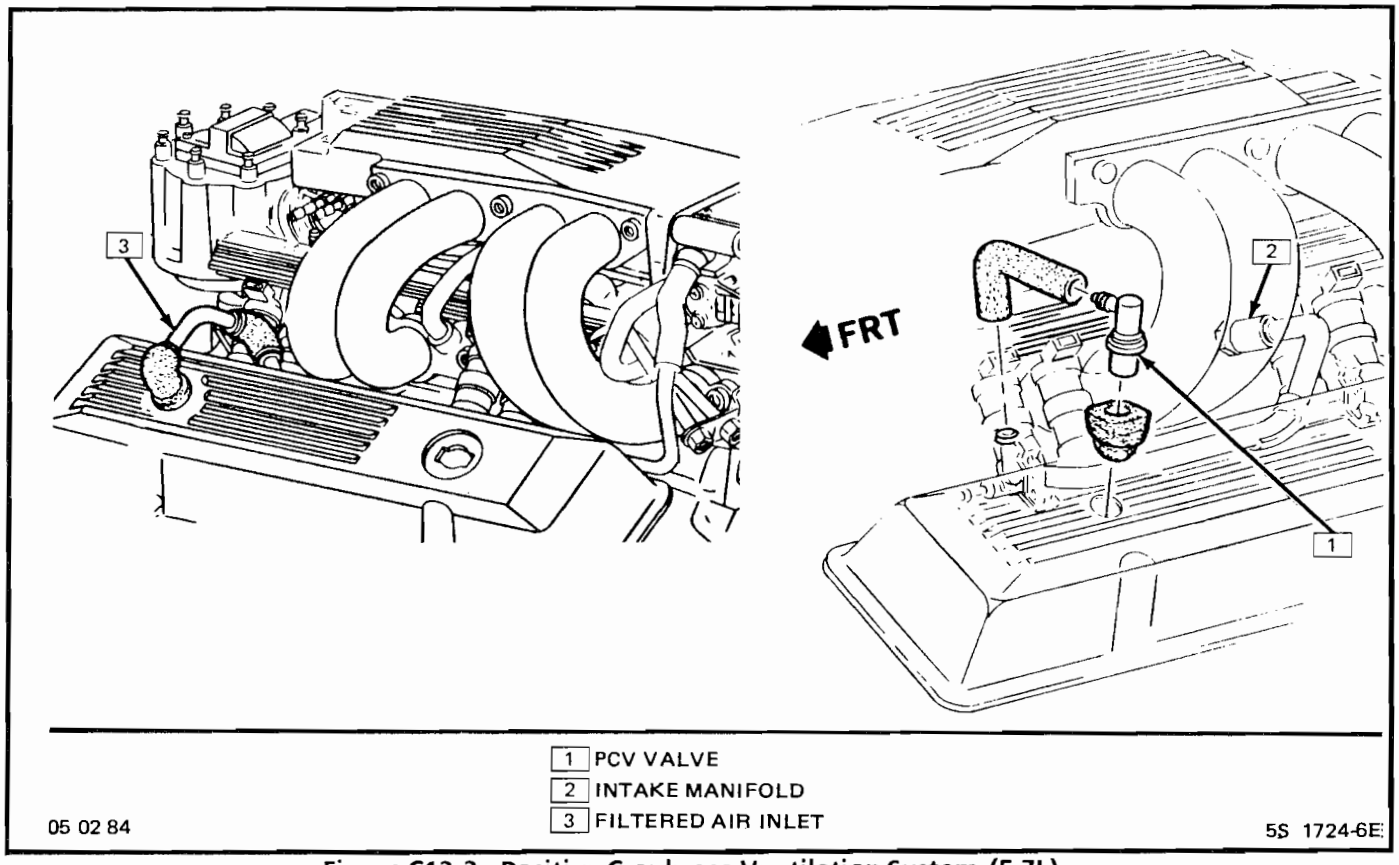


Figure C13-3 Positive Crankcase Ventilation System (5.7L)

SECTION 6F

ENGINE EXHAUST

CONTENTS

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Catalytic Converter 6F-1
ON-VEHICLE SERVICE 6F-1
Component Replacement 6F-1
Exhaust System Components 6F-3
Exhaust System Clearance 6F-4
Converter Air Pipe 6F-5
Exhaust Overtemp Sensor 6F-6

GENERAL INFORMATION

When inspecting or replacing exhaust system components, make sure there is adequate clearance from all points on the underbody to avoid possible overheating of the floor pan and possible damage to the passenger compartment insulation and trim materials.

Check complete exhaust system and nearby body areas for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the passenger compartment. Dust or water in the passenger compartment may be an indication of a problem in one of these areas. Any defects should be corrected immediately. To help insure continued integrity, the exhaust system pipe rearward of the catalytic converter must be replaced whenever a new muffler is installed.

Annoying rattles and noise vibrations in the Exhaust System are usually caused by misalignment of parts. When aligning the system, leave all bolts or nuts loose until all parts are properly aligned, then tighten, working from front to rear.

Periodic maintenance of the exhaust system is not required; however, if the vehicle is raised for other service, it is advisable to check the general condition of the catalytic converter, pipes and mufflers.

The installation of exhaust system supports is very important as improperly installed supports can cause annoying vibrations which are difficult to diagnose.

Two methods are used for connecting exhaust system slip joints, (1) clamp and (2) weld. When servicing a welded connection, it should be cut and the new connection clamped when installing replacement parts. Also coat slip joints with exhaust system sealer before assembling.

DIAGNOSIS

Refer to Figure 6F-1 for exhaust system diagnosis.

CATALYTIC CONVERTER

The catalytic converter is an emission control device added to the exhaust system to reduce pollutants from the exhaust gas stream. The catalyst in the converter is not serviceable.

The catalytic converter requires the use of unleaded fuel only.

ON-VEHICLE SERVICE

COMPONENT REPLACEMENT

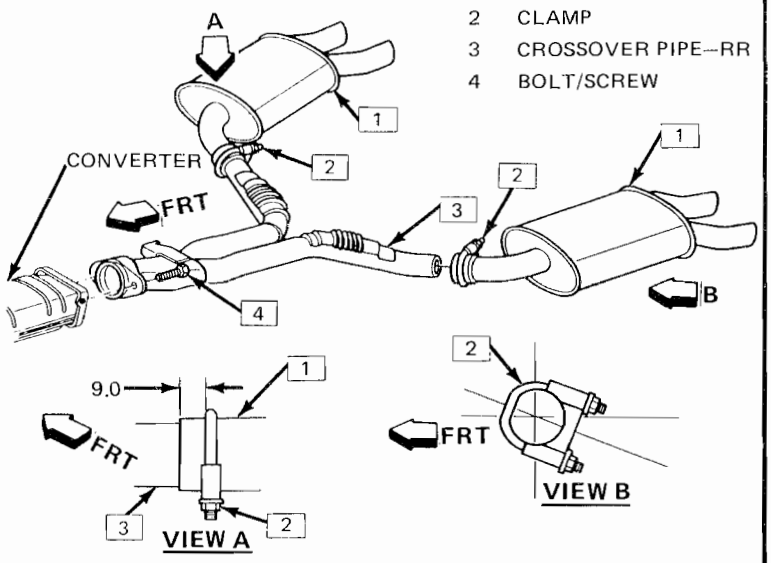
Refer to Figures 6F-2 through 6F-6 for component replacement of the exhaust system.

EXHAUST SYSTEM DIAGNOSIS

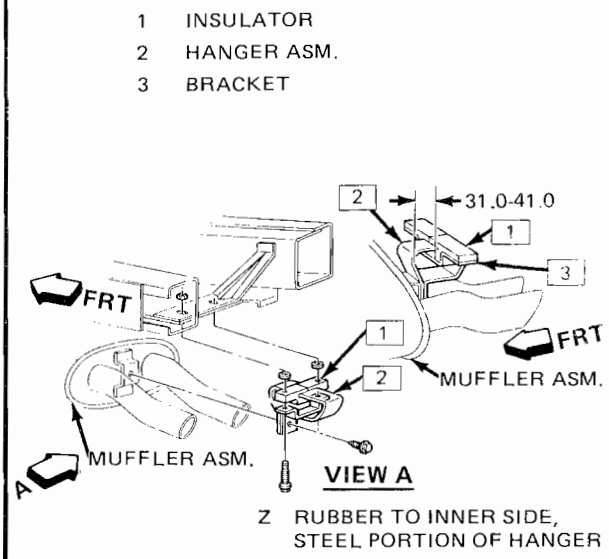
CONDITION	POSSIBLE CAUSE	CORRECTION
Leaking Exhaust Gases.	Leaks at pipe joints.	Tighten U-bolt nuts at leaking joints to 45 ft. lbs.
	Damaged or improperly installed gaskets.	Replace gaskets as necessary.
	Loose exhaust pipe connections.	Tighten stud nuts or bolts to specifications.
	Burned or rusted out exhaust pipes.	Replace as required.
Exhaust Noises.	Leaks at manifold or pipe connections.	Tighten clamps at leaking connections to specified torque. Replace gasket as required.
	Burned ar blown out muffler.	Replace muffler assembly.
	Burned ar rusted out exhaust pipe.	Replace exhaust pipe.
	Exhaust pipe leaking at manifold flange.	Tighten attaching bolts nuts to 17 foot-pounds.
	Exhaust manifald cracked or broken.	Replace manifold.
	Leak between manifold and cylinder head.	Replace gaskets, tighten manifold to cylinder head stud nuts or bolts to specifications.
Loss af engine pawer and/or internal rattles in muffler.	Dislodged turning tubes and/or baffles in muffler.	Replace muffler.
	Plugged Catalytic Converter (may result from serious engine malfunction).	Replace Catalytic Converter.

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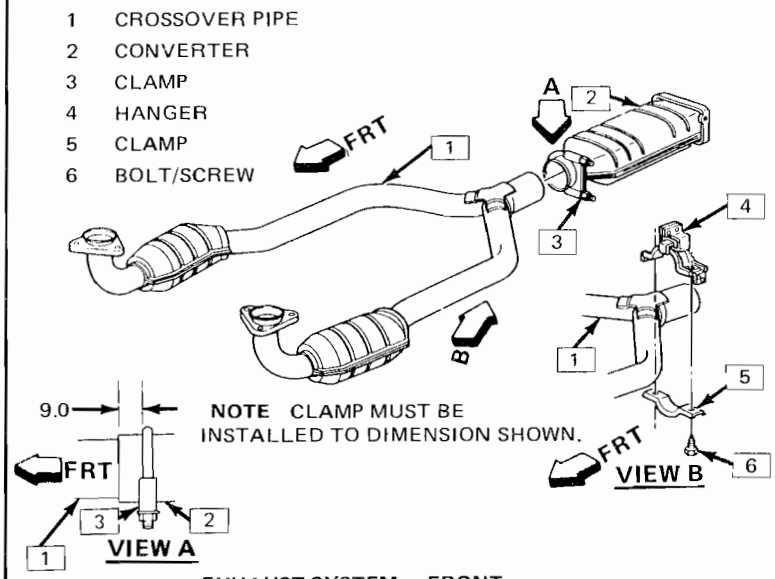
Figure 6F-1 Exhaust System Diagnosis



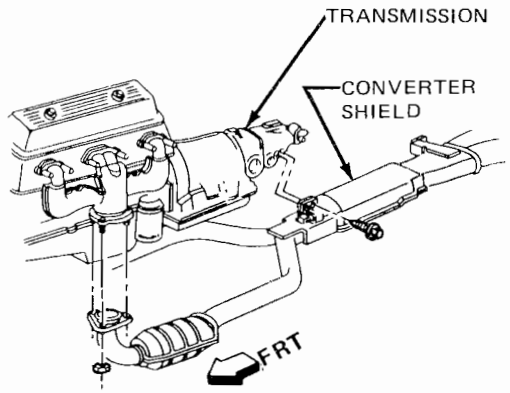
EXHAUST SYSTEM – REAR



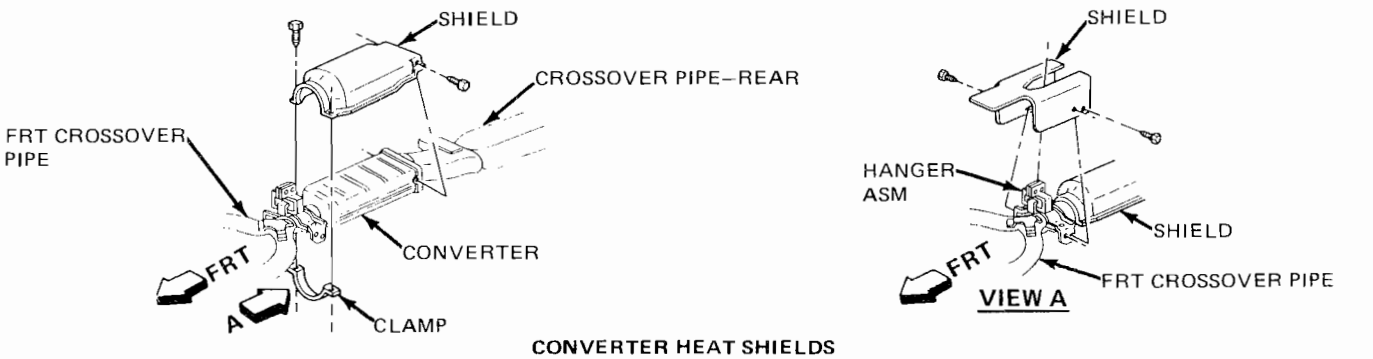
EXHAUST SYSTEM – REAR INSTALLATION



EXHAUST SYSTEM – FRONT

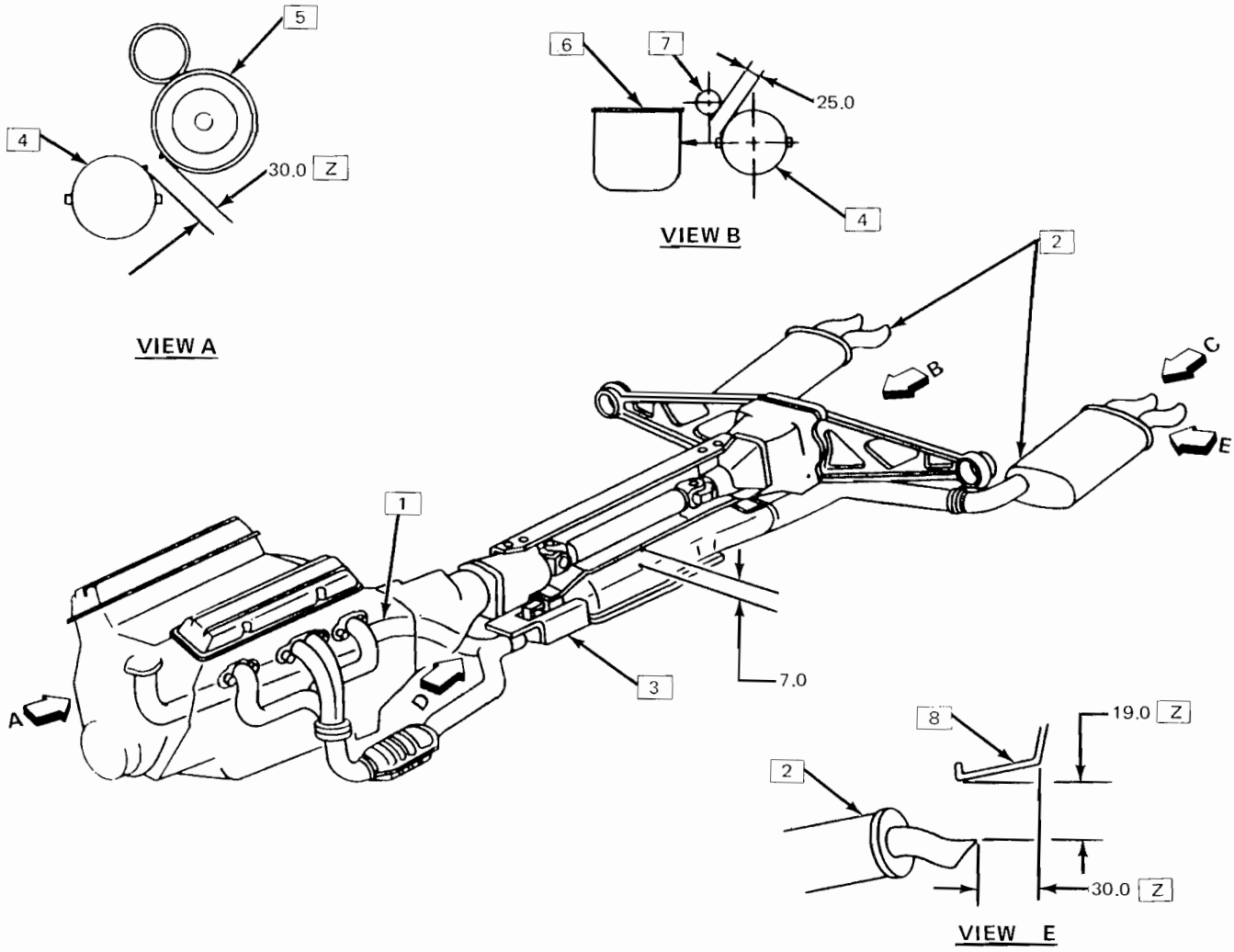


EXHAUST SYSTEM – FRONT



CONVERTER HEAT SHIELDS

Figure 6F-2 Exhaust System Components and Heat Shield



Z ALL CLEARANCE TOLERANCES TO BE ± 8.0

1. C/OVER PIPE
2. MUFFLER & TAILPIPE ASM.
3. HEAT SHIELD
4. CATALYTIC CONVERTER
5. STARTER MOTOR
6. OIL FILTER
7. CLUTCH SLAVE CYLINDER
8. REAR FACIA
9. CONNECTOR CTLTC CONVERTER
10. CONVERTER HEAT SHIELD
11. UNDERBODY PANEL
12. FRAME EXT.

Figure 6F-3 Exhaust System Clearance Requirements

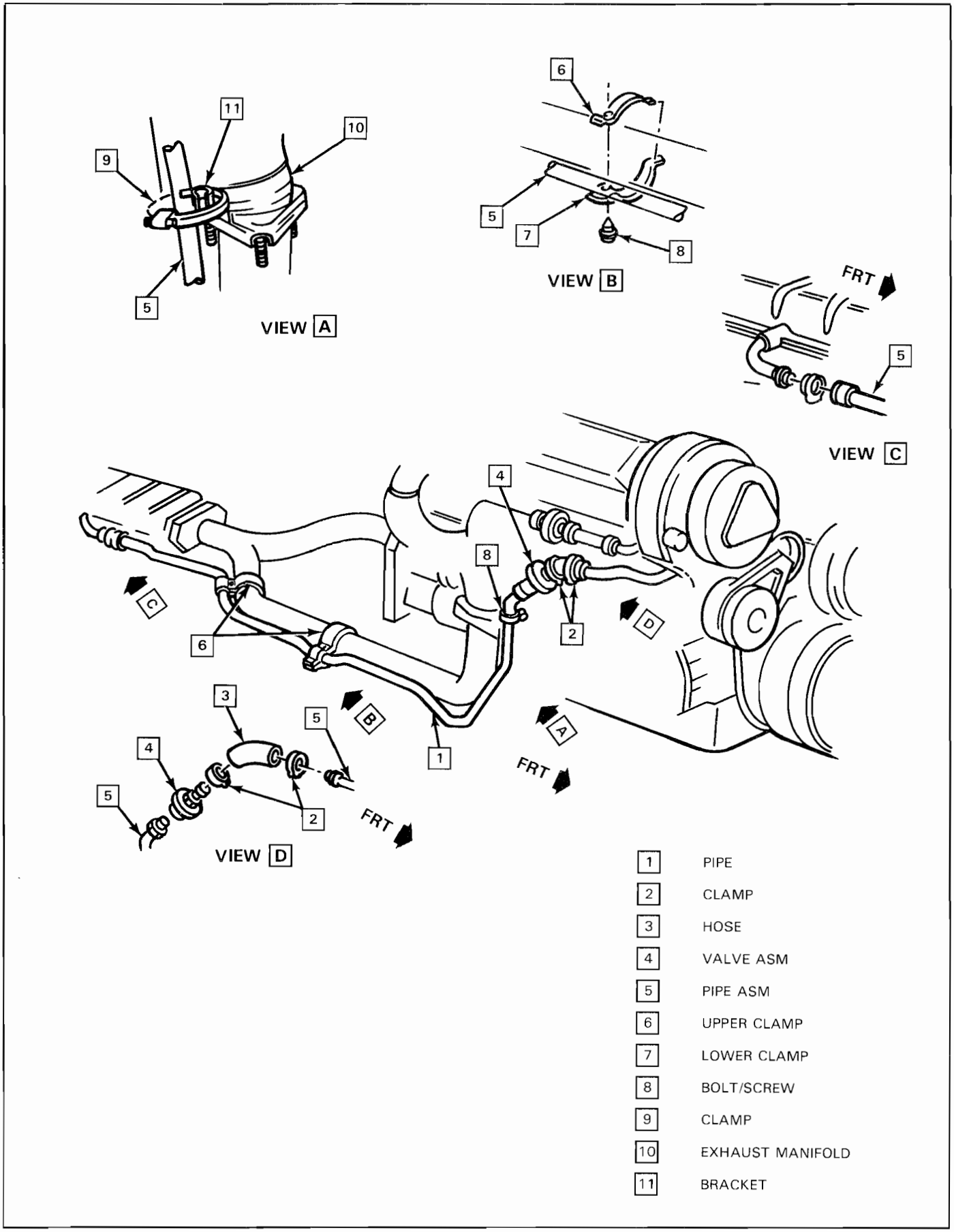
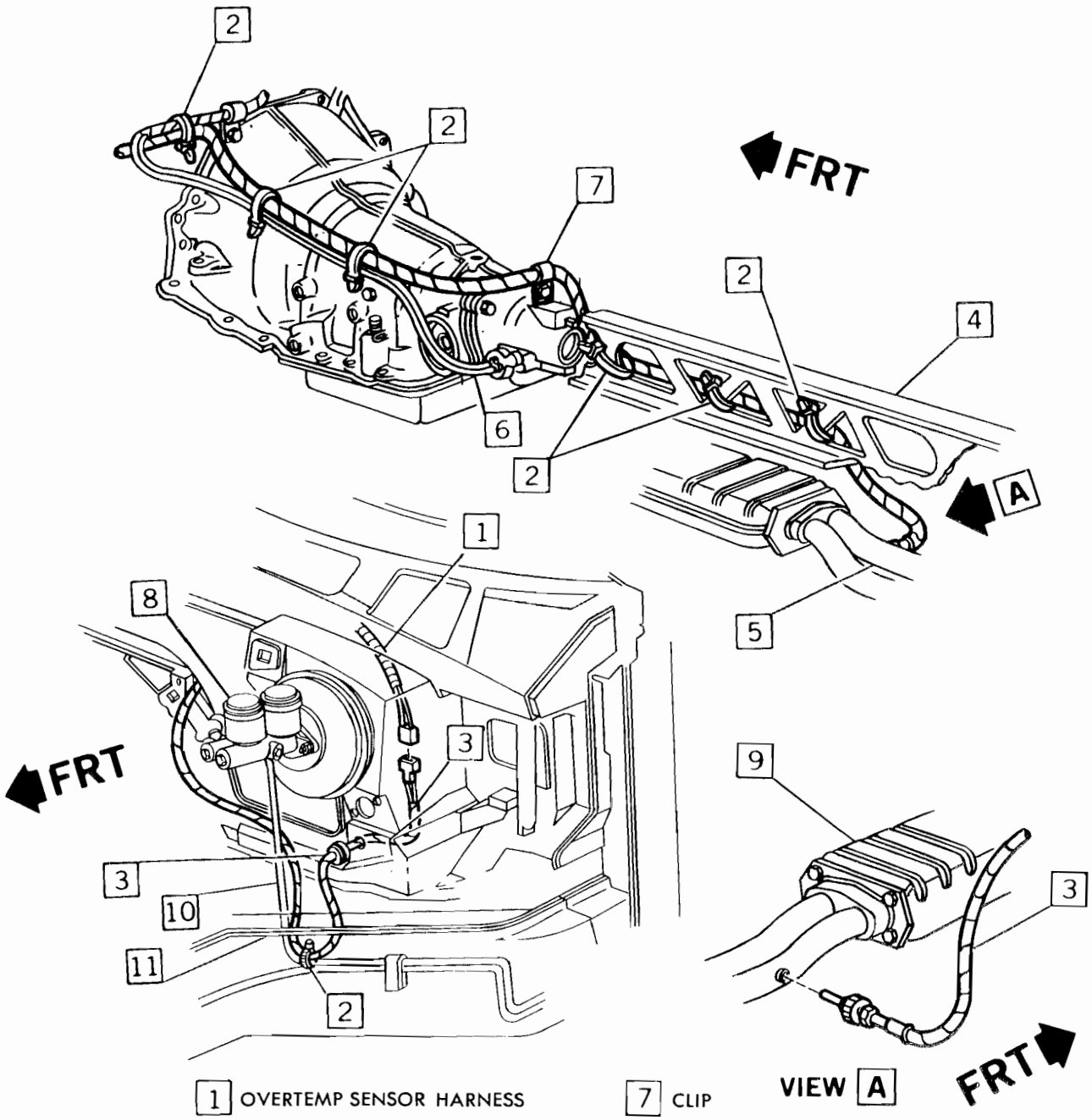


Figure 6F-5 Converter Air Pipe



1 OVERTEMP SENSOR HARNESS
2 STRAP
3 SENSOR
4 PROP SHAFT SUPPORT
5 REAR CROSSOVER PIPE
6 VEHICLE SPEED SENSOR WIRING
7 CLIP
8 MASTER CYLINDER
9 CONVERTER
10 FRONT REAR BRAKE PIPE
11 FUEL VAPOR PIPE

Figure 6F-6 Exhaust Overtemp Sensor - Export Only

SECTION 7

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SECTION 7A

AUTOMATIC TRANSMISSION

GENERAL INFORMATION

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TRANSMISSION FLUID LEVEL INFORMATION 7A-3
TRANSMISSION FLUID LEVEL CHECKING PROCEDURE 7A-3

The information contained in this section is common to all automatic transmissions. For on-vehicle service procedures refer to Section 7A2. For complete Diagnosis and Unit Repair refer to the specific transmission sections.

For vehicles sold in Canada also refer to the appropriate Canadian Service Manual Supplement for driveability diagnosis.

TRANSMISSION IDENTIFICATION INFORMATION

All automatic transmissions have a metal identification nameplate attached to the case exterior. The location of this name plate is shown in Figure 1. The information on the nameplate will assist in the servicing and determination of replacement parts when ordered through a GM Parts Catalog.

Additional Transmission identificaiton is provided on the Service Parts Identification Label. This label contains information on the regular production options (RPO) as well as standard and mandatory options. This label is affixed to the inside of each vehicle at the assembly plant. Refer to Section 0A of this Service Manual for label location and information.

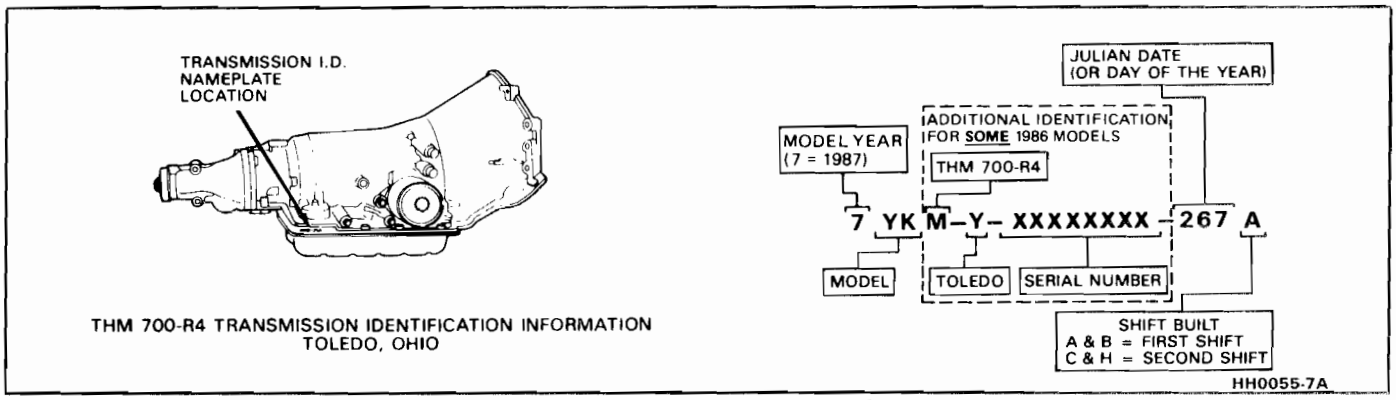


Figure 1 Transmission Identification Information

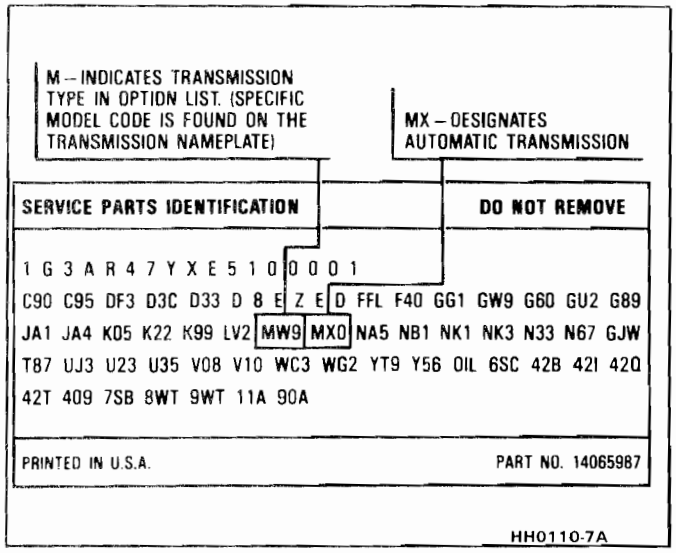


Figure 2 Service Parts Identificaiton Label

TRANSMISSION DEFINITIONS

The following definitions are being provided to establish a common language and assist the user in describing transmission related conditions. Some of these terms or conditions are used in the transmission sections of this Service Manual.

Throttle Positions

- **Minimum Throttle** - the least amount of throttle opening required for an upshift.
- **Light Throttle** - approximately 1/4 of accelerator pedal travel.
- **Medium Throttle** - approximately 1/2 of accelerator pedal travel.
- **Heavy Throttle** - approximately 3/4 of the accelerator pedal travel.
- **Wide Open Throttle (WOT)** - full travel of the accelerator pedal.
- **Full Throttle Detent Downshift** - a quick apply of the accelerator pedal to its full travel, forcing a downshift.
- **Zero Throttle Coastdown** - a full release of the accelerator pedal while the vehicle is in motion and in drive range.
- **Engine Braking** - a condition where the engine is used to slow the vehicle by manually downshifting during a zero throttle coastdown.

Shift Conditions

- **Bump** - a sudden and forceful apply of a clutch or band.
- **Chuggle** - a bucking or jerking condition that may be engine related. May be most noticeable when the converter clutch is engaged. Similar to the feel of towing a trailer.
- **Delayed** - a condition where a shift is expected but does not occur for a period of time. Samples of this condition could be described as clutch or band engagement does not occur as quickly as expected during a part throttle or wide open throttle apply of the accelerator or, when manually downshifting to a lower range. Also defined as "LATE" or, "EXTENDED."
- **Double Bump ("Double Feel")** - two sudden and forceful applies of a clutch or band.
- **Early** - a condition where the shift occurs before the vehicle has reached a proper speed and tends to labor the engine after the upshift.
- **End Bump** - a firmer feel at the end of a shift as compared to the feel at the start of the shift. Also defined as "END FEEL" or, "SLIP BUMP."
- **Firm** - a noticeable quick apply of a clutch or band that is considered **normal** with a medium to heavy throttle shift. Should not be confused with "HARSH" or "ROUGH."
- **Flare** - a quick increase in engine rpm accompanied with a momentary loss of torque. This most generally occurs during a shift. Also defined as "SLIPPING."
- **Harsh ("Rough")** - a more noticeable apply of a clutch or band as compared to "FIRM." This condition is considered undesireable at any throttle position.
- **Hunting** - a repeating quick series of upshifts and downshifts that causes a noticeable change in engine rpm. An example could be described as a 4-3-4 shift pattern. Also defined as "BUSYNESS."
- **Initial Feel** - a distinct firmer feel at that start of a shift as compared to the finish of the shift.
- **Late** - a shift that occurs when the engine is at a higher than normal rpm for a given amount of throttle.
- **Shudder** - a repeating jerking sensation similar to "CHUGGLE" but more severe and rapid in nature. This condition may be most noticeable during certain ranges of vehicle speed. May also be used to define the condition after converter clutch engagement.
- **Slipping** - a noticeable increase in engine rpm without a vehicle speed increase. A slip usually occurs during or after initial clutch or band engagement.
- **Soft** - a slow, almost unnoticeable clutch apply with very little shift feel.
- **Surge** - a repeating engine related feeling of acceleration and deceleration that is less intense than "CHUGGLE."
- **Tie-Up** - a condition where two opposing clutches are attempting to apply at the same time causing the engine to labor with a noticeable loss of engine rpm.

Noise Conditions

- **Gear Noise** - a whine, most noticeable in first gear and reverse that is related to vehicle speed. A gear noise condition may become less noticeable or go away after an upshift.
- **Pump Noise** - a high pitch whine that increases in intensity with engine rpm. This condition may also be noticeable in PARK and NEUTRAL operating ranges with the vehicle stationary.

PRELIMARY CHECKING PROCEDURE

The condition of an automatic transmission not operating properly may be influenced by one, or a combination of the following items:

- Fluid level high/low
  (Refer to Section 7A2)
- Engine performance
  (Refer to Sections 6 and 6E)
- T.V. cable adjustment
  (Refer to Section 7A2)
- Manual linkage adjustment
  (Refer to Section 7A2)
- Internal fluid leaks
  (Refer to Transmission Unit Repair section)
- Electrical system
  (Refer to Section 6E and 8A)
- Transmission or other mechanical component
  (Refer to Transmission Unit Repair section)
- Vacuum modulator
  (Refer to appropriate Hydraulic Diagnosis Section)

NOISE AND VIBRATION ANALYSIS

A noise or vibration that is noticeable when the vehicle is in motion, MAY NOT be the result of the transmission.

If noise or vibration is noticeable in "Park" (P) and "Neutral" (N) with engine at idle, but is less noticeable as RPM's increase, the cause may be from poor engine performance.

Inspect

- Tires for
  - Uneven wear
  - Imbalance
  - Mixed sizes
  - Mixed radial and bias ply
    (Refer to Section 3E)
- Suspension components for
  - Alignment and wear
  - Loose fasteners
    (Refer to Section 3C)
- Engine/Transmission mounts for
  - Damage
  - Loose bolts
    (Refer to Sections 6A and 7A2)
- Transmission case mounting holes for:
  - Missing bolts, nuts, studs
  - Stripped threads
  - Cracks
- Flexplate for:
  - Missing or loose bolts
  - Cracks
  - Imbalance
    (Refer to Section 6A)
- Torque converter for:
  - Missing or loose bolts or lugs
  - Missing or loose balance weights
  - Imbalance

TRANSMISSION FLUID LEVEL INFORMATION

Checking fluid level, color and condition at regular intervals will provide early diagnosis information about the transmission. This information may then be used to correct a condition that, if not detected early, could result in major transmission repairs.

When adding or changing fluid, use only DEXRON® II, or equivalent. Refer to Section 0B of this Service Manual for maintenance information and servicing intervals.

- Fluid level should be checked when it reaches normal operating temperatures of 190-200°F. (88-93°C). This temperature is reached after approximately 15 miles (24 km) of highway driving.
- Fluid color
  - Should be dark red (may be dark green)

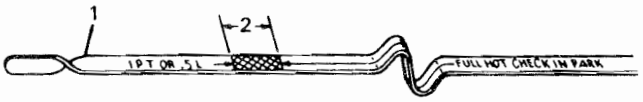
NOTICE: Do not overfill. Overfilling will cause foaming, loss of fluid and possible damage to the transmission.

- Inaccurate fluid level readings will result if checked immediately after the vehicle has been operated:
  - In high abmient temperatures above 90°F (32°C)
  - At sustained high speeds
  - In heavy city traffic during hot weather
  - As a towing vehicle
  - In commercial service (taxi or police use)

TRANSMISSION FLUID CHECKING PROCEDURE

(Refer to Figure 3)

1. Park vehicle on level ground.
2. Apply parking brake and block wheels.
3. Start engine and operate vehicle for 15 minutes or until normal operating temperature is reached.
4. Move gear selector through all gear positions.
5. Move gear selector to "Park" (P).
6. Check fluid level, color and condition.



1 FLUID LEVEL INDICATOR
2 LEVEL TO BE IN CROSS-HATCHED AREA ON FLUID LEVEL INDICATOR BLADE. CHECK AT OPERATING TEMPERATURE.

CHECKING FLUID COLOR, LEVEL AND CONDITION

- CHECK FLUID COLOR
  - RED (OR GREEN)
    - CHECK FLUID LEVEL
      - OK → ADD FLUID TO OBTAIN PROPER LEVEL → – RECHECK COLOR AND LEVEL
      - LOW
        - CHECK FOR EXTERNAL LEAKS (REFER TO SECTION 7A2)
        - ADD FLUID TO OBTAIN PROPER LEVEL → – RECHECK COLOR AND LEVEL
      - HIGH → REMOVE EXCESS FLUID → – RECHECK COLOR AND LEVEL
      - FOAMS
        - REMOVE EXCESS FLUID → – RECHECK COLOR AND LEVEL
        - CHECK FOR CONTAMINATION (REFER TO SECTION 7A2) → – PERFORM ROAD TEST (REFER TO HYDRAULIC DIAGNOSIS SECTION)
      - UNUSUAL ODOR → REFER TO SECTION 7A2 FOR CONDITION OF FLUID → – PERFORM ROAD TEST (REFER TO HYDRAULIC DIAGNOSIS SECTION)
  - PINK → – LOCATE SOURCE OF CONTAMINATION (REFER TO SECTION 6B) → – TRANSMISSION OVERHAUL REQUIRED (REFER TO UNIT REPAIR SECTION) → – RECHECK COLOR AND LEVEL
  - BROWN → – LOCATE SOURCE OF CONTAMINATION (REFER TO SECTION 6B) → – TRANSMISSION OVERHAUL REQUIRED (REFER TO UNIT REPAIR SECTION) → – RECHECK COLOR AND LEVEL

HH0180-7A

Figure 3 Checking Fluid Color, Level and Condition

SECTION 7A2

AUTOMATIC TRANSMISSION ON CAR SERVICE

RPO-MD8

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For vehicles sold in Canada also refer to the appropriate Canadian Service Manual Supplement for driveability diagnosis.

GENERAL SERVICE PROCEDURES

PARTS CLEANING, INSPECTION AND REPLACEMENT

- Use appropriate safety equipment such as:
  - Safety glasses
  - Safety shoes
  - Gloves
- Keep work area and tools clean
- Clean transmission exterior before removing parts
- Do not use wipe cloths or rags
- Do not use solvents on:
  - Rubber seals
  - Plastic/Teflon® thrust washers
- Blow out all passages with compressed air
- Clean out small passages with fine wire
- Handle parts carefully to prevent damage
- Lubricate all internal parts with transmission fluid during assembly
- When installing screws, bolts or studs into aluminum always dip the threads in transmission fluid
- Always use a torque wrench for proper torque
- Recondition damaged or stripped aluminum threads with thread inserts
- Replace all gaskets and o-ring seals
  - Do not use gasket cement or sealers
- Replace Teflon® and rubber lip seals only when necessary and install using the appropriate seal protector

Inspect

- Manual linkage for:
  - Wear at pivoting points
  - Bent or broken links and rods
- All seals, gaskets, o-rings and mating surfaces for:
  - Nicks
  - Cuts
  - Damage
- Snap rings for:
  - Expansion or compression
  - Distortion
  - Nicks
  - Proper ring to groove fit
- Bearings and thrust surfaces for:

- Wear
- Scoring
- Pitting

FLYWHEEL/TORQUE CONVERTER VIBRATION TEST PROCEDURE

1. Start engine
2. With engine at idle speed and the transmission in "Park" (P) or "Neutral" (N), observe vibration.
3. Shut off engine.

Remove or Disconnect

- Converter cover attaching bolts
- Flywheel to torque converter attaching bolts
- Rotate torque converter 120 (1/3 turn)

Install or Connect

- Flywheel to torque converter attaching bolts
  - Torque bolts to 62 N·m (45 lbs. ft.)
- Converter cover bolts
  - Torque bolts to 10 N·m (89 lbs. in.)

4. Start engine and check for vibration. Repeat this procedure until the best possible balance is obtained.

NOTICE: Some engine/transmission combinations cannot be balanced in this manner due to limited clearances between the torque converter bolts and engine. Be sure bolts do not bottom out in lug nuts or the torque converter cover could be dented and cause internal damage.

FLUID LEAK DIAGNOSIS

The cause of most external leaks can generally be located and repaired with the transmission in the car.

METHODS FOR LOCATING LEAKS

General Method

- Verify that the leak is transmission fluid.
- Thoroughly clean the suspected leak area.
- Operate the car for about 15 miles or until normal operating temperatures are reached.
- Park the car over clean paper or cardboard.
- Shut off engine and look for fluid spots on paper.
- Make necessary repairs.

Powder Method

- Thoroughly clean the suspected leak area with solvent.
- Apply an aerosol type powder (foot powder) to the suspected leak area.
- Operate the car for about 15 miles or until normal operating temperatues are reached.
- Shut off engine.
- Inspect suspected leak area and trace the leak path through the powder to find the source.
- Make necessary repairs.

Dye And Black Light Method

A fluid dye and black light kit is available from various tool manufacturers.

- Follow the manufacturer's recommendations for the amount of dye to be used.
- Detect the leak with the black light.
- Correct cause of leak.

REPAIRING THE LEAK

Once the leak has been pinpointed and traced back to its source, the cause of the leak must be determined in order for it to be repaired properly. If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check to be sure that the following conditions are correct as they may cause a leak.

Gaskets

- Fluid level/pressure is too high.
- Plugged vent or drain-back holes.
- Improperly torqued fasteners or dirty/damaged threads.
- Warped flanges or sealing surface.
- Scratches, burrs or other damage to the sealing surface.
- Damaged or worn gasket.
- Cracking or porosity of the component.
- Improper sealant used (where applicable).

Seals

- Fluid level/pressure is too high.
- Plugged vent or drain-back holes.
- Damaged seal bore (scratched, burred or nicked).
- Damaged or worn seal.
- Improper installation.
- Cracks in component.
- Manual or output shaft surface scratched, nicked or damaged.
- Loose or worn bearing causing excess seal wear.

Possible Points of Oil Leak

1. **Transmission/Transmission oil pan :**
   - Attaching bolts not correctly torqued
   - Improperly installed or damaged gasket
   - Oil pan or mounting face not flat
2. **Case Leak :**
   - Filler tube "multi-lip seal" damaged or missing
   - Filler tube bracket mislocated
   - T.V. cable "multi-lip" seal missing, damaged or improperly installed
   - Governor cover or "O" ring damaged or missing
   - Speedometer driven gear/speed sensor seal damaged
   - Manual shaft seal damaged
   - Oil cooler connector fittings loose or damaged

- Propeller shaft oil seal worn or damaged
- Governor cover
- Line pressure pipe plug loose
- Porous casting

3. **Leak at converter end:**
   Converter seal damaged
   - Seal lip cut. (Check converter hub for damage.)
   - Bushing moved forward and damaged
   - Garter spring missing from seal
   - Converter leak in weld area. (Refer to Torque Converter.)
   - Porous casting (Case or pump)
4. **Fluid comes out vent pipe or fill tube:**
   - Over-filled
   - Water or coolant in fluid. Fluid will appear milky.
   - Case porous
   - Incorrect fluid level indicator
   - Plugged vent
   - Drain back holes plugged
   - Mispositioned oil pump to case gasket (if equipped)

Case Porosity Repair

1. Clean the leak area with solvent and air dry.
   CAUTION: Epoxy adhesive may cause skin irritations and eye damage. Read and follow all information on the container label as provided by the manufacturer.
2. Mix a sufficient amount of epoxy adhesive, #1052533, or equivalent, following the manufacturer's recommendations.
3. While the transmission case is hot, apply epoxy adhesive with a clean, dry soldering acid brush.
4. Allow the epoxy adhesive to cure for three hours before starting the engine.
5. Repeat fluid leak diagnosis procedures.

TORQUE CONVERTER CLUTCH ELECTRICAL CONTROLS

The Torque Converter Clutch (TCC) system uses controls that are internal as well as external to the transmission. For internal control components of the TCC system, refer to the Hydraulic Diagnosis Section for for wiring diagrams and switch locations.

The external control components of the TCC system include:

1. **Brake Release Switch** - To avoid stalling the engine when braking, the converter clutch is released any time the brakes are applied.
2. **Electronic Control Module** - Receives input signals and grounds TCC solenoid to apply clutch when proper operating conditions are met.
3. **Throttle Position Sensor** - Sends throttle position information to Electronic Control Module.
4. **Vacuum Sensor** - Sends engine vacuum (load) information to Electronic Control Module.
5. **Vehicle Speed Sensor** - Sends vehicle speed information to Electronic Control Module.
6. **Coolant Temperature Sensor** - Sends engine coolant temperature information to Electronic Control Module.

TORQUE CONVERTER CLUTCH DIAGNOSIS

To properly diagnose the Torque Converter Clutch (TCC) system perform all electrical testing first and then the hydraulic testing. Refer to the appropriate Driveability and Emissions Section (6E) for additional Torque Converter Clutch Information

ON-CAR SERVICE

SHIFT CONTROL CABLE

Remove or Disconnect (Fig. 1)

1. Negative battery cable.
2. Raise car and suitably support, see Section OA.
3. Cable attachments at transmission.
4. Lower car.
5. Console, see Section 8C.
6. Cable at control lever and base.
7. Cable from floor.

Install or Connect

1. Cable to floor.
2. Cable at base and control lever.
3. Console, see Section 8C.
4. Place control lever in "NEUTRAL".
5. Raise car.
6. Cable attachments at transmission.
7. Adjust cable.
8. Lower car.
9. Negative battery cable.

Adjust (Fig. 1)

1. Place control lever in "N" (Neutral).
2. Raise car and suitably support, see Section 0A.
3. Loosen cable attachment at shift lever.
4. Rotate shift lever "clockwise" to park detent and then back to neutral.
5. Tighten cable attachment.
   - 20 N·m (15 lbs. ft.)

   Important

   Lever must be held out of "PARK" when torquing nut.
6. Lower car.
7. Check cable adjustment by rotating control lever thru the detents.

FLOORSHIFT CONTROL

Remove or Disconnect (Fig. 2)

1. Negative battery cable.
2. Shift knob and console, see Section 8C.
3. Cable at control lever and base.

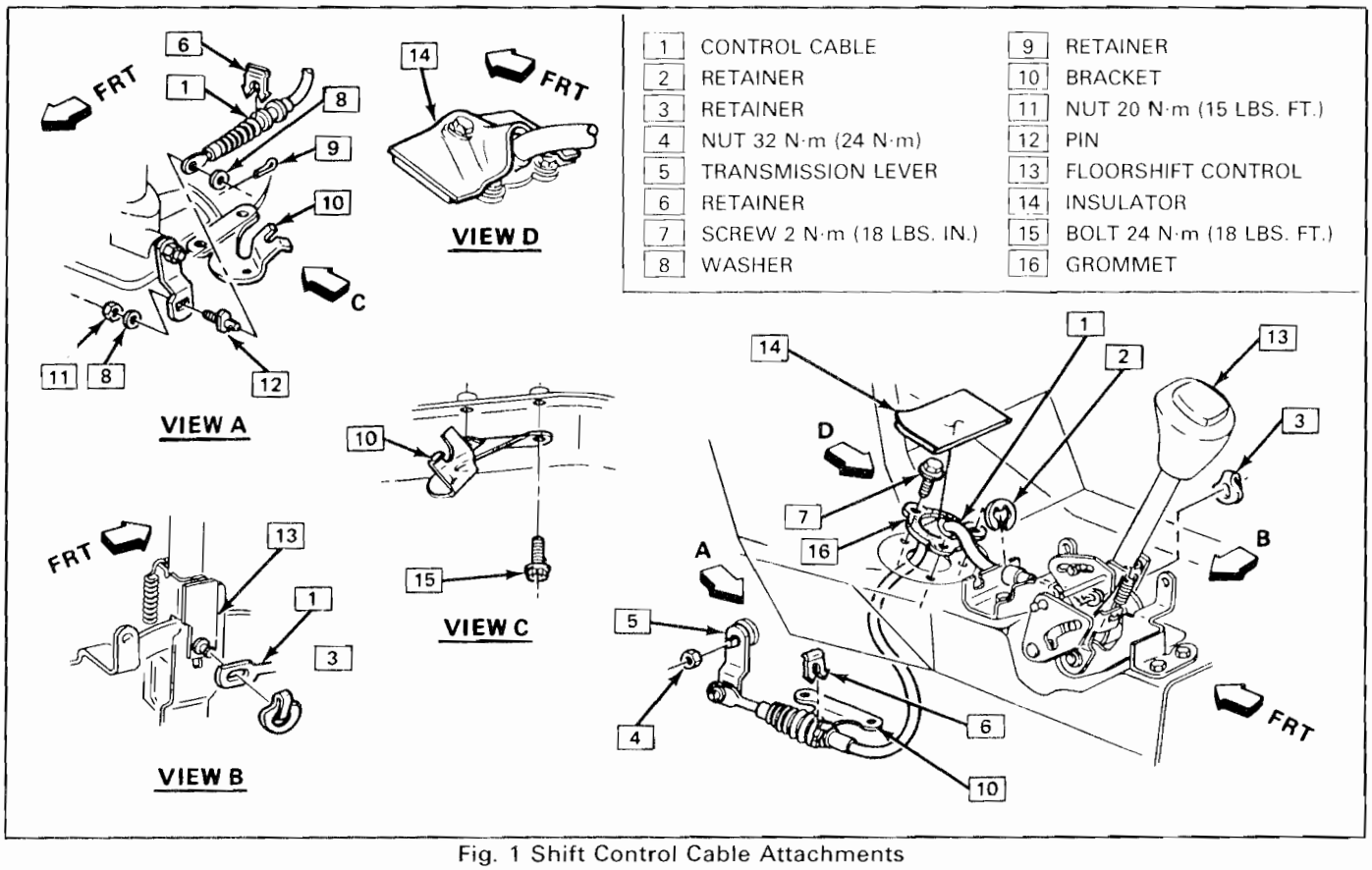


Fig. 1 Shift Control Cable Attachments

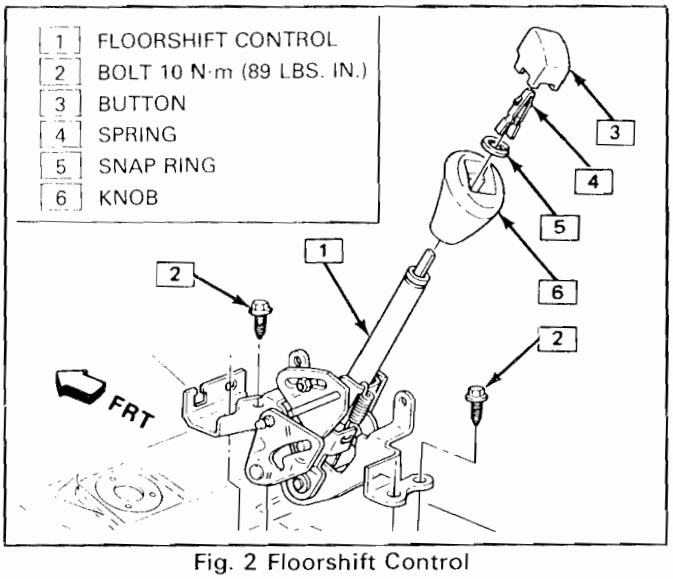


Fig. 2 Floorshift Control

4. Neutral start/back-up lamp switch.
5. Park lock cable.
6. Floorshift control bolts.

Install or Connect

1. Floorshift control bolts.
   - 10 N·m (89 lbs. in.)
2. Neutral start/back-up lamp switch.
   - 3 N·m (26 lbs. in.)
   - Adjust switch
3. Cable at base and control lever.
4. Park lock cable.
   - Adjust cable
5. Console and shift knob, see Section 8C.
6. Adjust shift control cable.
7. Negative battery cable.

PARK/LOCK CONTROL CABLE

Remove or Disconnect (Fig. 3)

1. Negative battery cable
2. Shifter knob
3. Console, see Section 8C.
4. Place transmission control lever in "Park".
5. Lift cable connector lock button at the shifter base to the up position.
6. Cable from park lock lever pin.
7. Depress two cable connector latches and remove from shifter base.
8. Cable clips

9. Cable from steering column pin and bracket.

Install or Connect

1. With cable lock button in the up position and shift lever in the "Park" position, snap cable connector into shifter base.
2. Cable end onto shifter park lock lever pin.
3. Cable to steering column bracket.
4. Snap cable on steering column pin.
5. Push cable up to the lock position on steering column.
6. Apply pressure rearward on shift lever in the "Park" detent.
7. Push cable lock button down.
8. Console, see Section 8C.
9. Shift knob.
10. Negative battery cable.

Inspect

- Functional Operation
  1. With the shift lever in "Park" and the key in "Lock" position, make sure that you cannot move the shifter lever to another position. Ignition key should be removable from column.
  2. With the key in "run" and the shift lever in "Neutral", make sure that you cannot turn the key to "Lock".
  3. If the above conditions are met, the system is properly adjusted.

PARK/NEUTRAL AND BACK-UP LAMP SWITCH

Remove or Disconnect (Fig. 4)

1. Negative battery cable.
2. Shifter knob.
3. Console, see Section 8C.
4. Mounting nuts.
5. Switch

Using Old Switch

Install or Connect

1. Place shift control lever in "NEUTRAL".
2. Align carrier tang on switch with tang slot on shift control.
3. Assemble mounting nuts-to-case, loosely.
4. Rotate switch to align service adjustment hole with carrier tang hole.
5. Insert gage pin (2.34mm/3/32") in service adjustment hole and rotate switch until pin drops in to a depth of 15 mm (19/32").
6. Torque nuts.
   - 3 N·m (26 lbs. in.).
7. Gage pin
8. Console, see Section 8C.
9. Shifter knob.
10. Negative battery cable.

Important

- After switch adjustment, verify that engine will only start in "PARK" or "NEUTRAL". If engine will start in any other position readjust switch.

Using New Switch

Install or Connect

1. Place shift control lever in "NEUTRAL".
2. Insert carrier tang on switch in slot on shifter.
3. Mounting nuts and torque.
   - 3 N·m (26 lbs. in.)

   If holes do not align with shift control verify shift control lever is in "NEUTRAL" position, do not rotate switch. Switch is pinned in "NEUTRAL" position.
   - If switch has been rotated and pin broken, switch can be adjusted by using the Using Old Switch" procedure.
4. Move shift control lever out of ""Neutral" position to shear plastic pin.

Important

- After switch installation verify that engine will only start in "PARK" and "NEUTRAL". If engine will start in any other position, readjust switch using "Old Switch" procedure.

5. Console, see Section 8C.
6. Shifter knob.
7. Negative battery cable.

T.V. CABLE

The T.V. cable used on the 700-R4 transmission controls line pressure, shift points, shift feel, part throttle downshifts and detent downshifts. The T.V. cable operates the throttle valve lever and bracket assembly in the control valve.

The Throttle Valve Lever and Bracket Assembly serves two (2) basic functions:

1. To transfer the throttle lever movement to the T.V. plunger in the control valve assembly. This causes T.V. pressure and line pressure to increase according to engine throttle opening and controls part throttle and detent downshifts.
2. To prevent the transmission from operating at low (idle) pressures, if the T.V. cable should become broken or disconnected. If the cable is not connected or broken, the T.V. lifter rod will not move from its normal position which holds the T.V. exhaust check ball off its seat. The T. V. lifter rod will drop down to allow the T.V. exhaust ball to seat only if the cable is broken, disconnected or out of adjustment. With the transmission pan removed, pull down on the T.V. exhaust valve lifter rod and the spring should return the rod to its normal up position. If the throttle valve lever and bracket assembly or lifter rod binds or sticks so that the T.V. lifter rod cannot lift the exhaust ball off its seat, high line

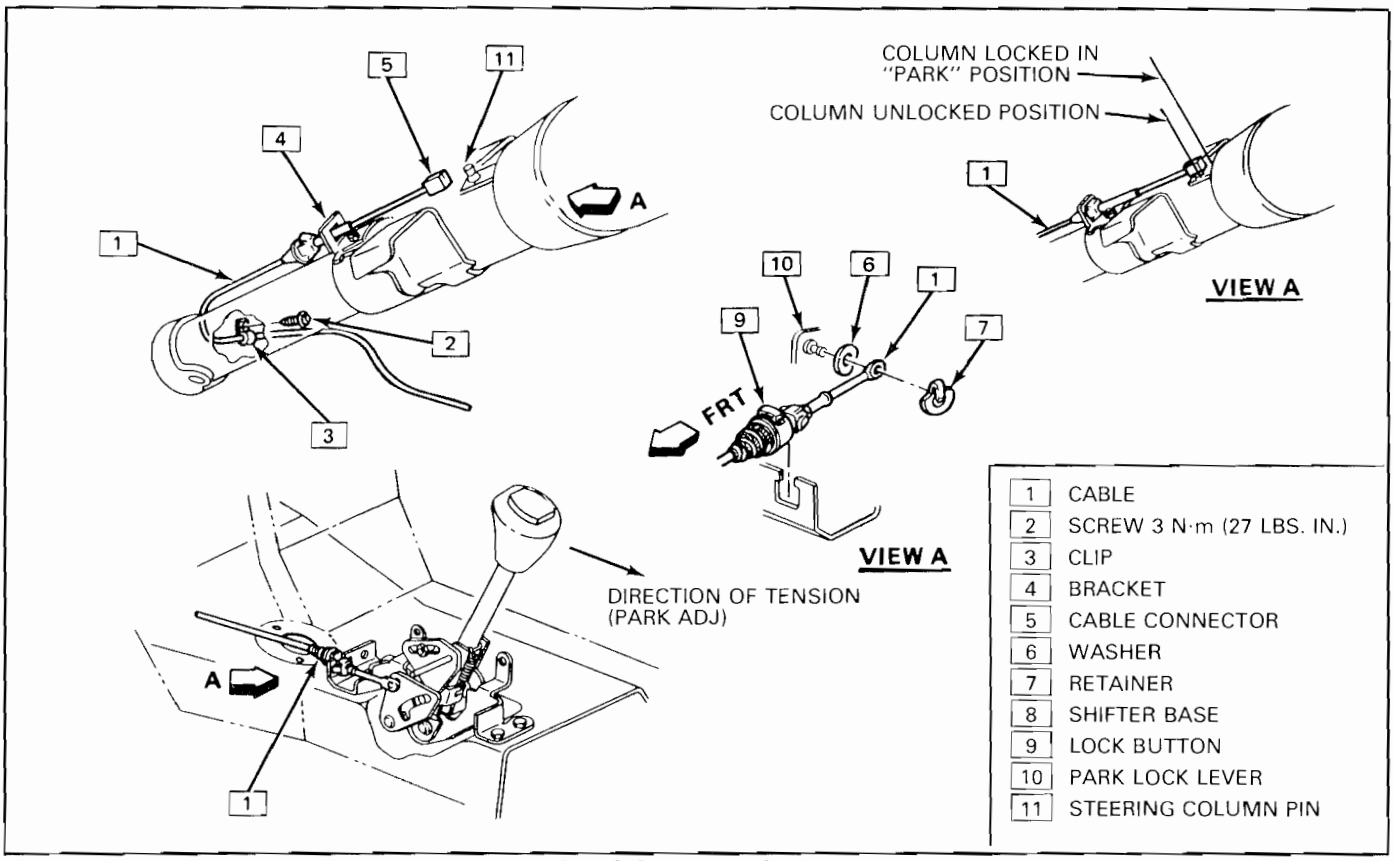


Fig. 3 Park Lock Cable

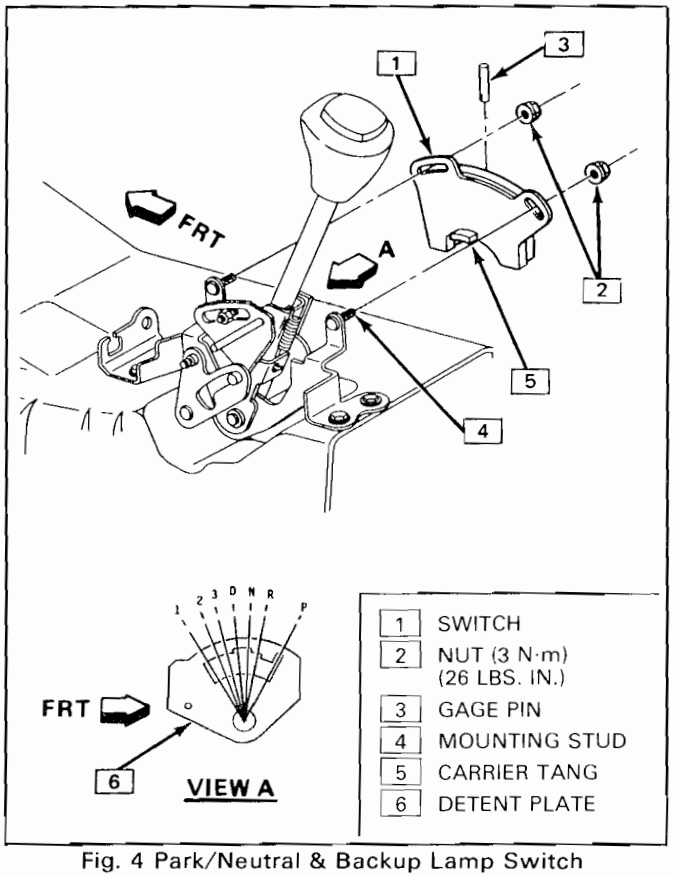


Fig. 4 Park/Neutral & Backup Lamp Switch

pressures and delayed upshifts will result. The T.V. lifter rod must not be bent or it will not function properly.

T.V. CABLE SYSTEM DIAGNOSIS

Inspect

CAUTION: To avoid possible personal injury and/or damage to the car, brakes must be applied at all times during the test.

1. Install oil pressure gage.
2. Install engine tachometer.
3. Warm up engine to proper operating temperature.
4. Run engine at 1000 RPM.
5. Apply parking brake.
6. Place gear selector in "PARK" and note oil pressure.
7. Place gear selector into "DRIVE". Oil Pressure should be equal or not more than 10 psi (34 kPa) higher than in "PARK".
8. Increase engine speed to 1400 RPM. If oil pressure does not increase, adjust T.V. cable. Refer to T.V. Cable Adjustment.

Remove or Disconnect (Fig. 5)

1. Air cleaner.
2. T.V. cable terminal from throttle lever.
3. Cable housing from bracket while compressing locking tangs.

4. Routing clips or straps.
5. Raise car and suitably support, see Section 0A.
6. Bolt securing T.V. cable to transmission.
   - Pull up on cable cover at transmission until cable is visible.
7. Cable from transmission link.
8. Cable seal.

Install or Connect

1. New seal into transmission case hole.
2. Transmission end of cable to T.V. link and secure to transmission case with bolt and washer assembly. Torque to 10 N·m (89 lb. in.).
3. Cable routing clips or straps.
4. Lower car.
5. Pass cable through engine bracket and engage locking tangs of cable on bracket.
6. Avoid damaging or kinking wire cable.
7. Cable terminal to throttle lever.

Inspect

- Pull on upper end of cable. It should travel a short distance with light resistance caused by the small return spring on the T.V. lever. When releasing the upper end of the T.V. cable, it should return to the zero T.V. position.

Adjust

- T.V. cable.

CHANGING FLUID AND FILTER

Remove or Disconnect

1. Raise the car and support, see Section 0A.
   Upper and lower underbody braces on vehicles with a convertible top.
2. Place drain pan under transmission oil pan.
3. Oil pan bolts from the front and sides only.
4. Loosen rear oil pan bolts approximately 4 turns.

NOTICE: Do not damage the transmission case or oil pan sealing surfaces.

5. Lightly tap oil pan with rubber mallet or pry to allow fluid to drain.
   - Inspect fluid color
   - Refer to chart in Section 7A
6. Remaining oil pan bolts, oil pan and gasket.
7. Oil filter and o-ring
   - O-ring may be stuck in the case

Clean

- Transmission case and oil pan gasket surfaces with solvent and air dry.
  - All traces of old gasket material must be removed

Install or Connect

- Coat o-ring seal with a small amount of petrolatum
- New o-ring onto filter
- New filter into case
- Oil pan and new gasket
- Oil pan bolts 20 N·m (15 lbs. ft.)

8. Lower car.
9. Fill transmission to proper level with DEXRON® II fluid or equivalent, see Section 7A.
10. Check "Cold" fluid level reading for initial fill. Do not overfill.
11. Follow the "Transmission Fluid Level Checking Procedure" in Section 7A of this Service Manual.
12. Check oil pan gasket for leaks.

700-R4 SERVICEABLE COMPONENTS

The following parts can be serviced with the transmission in the vehicle:

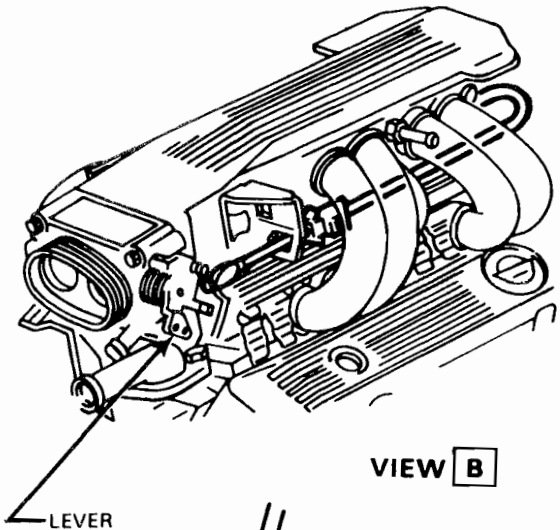
- Throttle valve control cable and/or sleeve seal
- Fill tube and/or seal
- Governor assembly
- Speedometer drive and/or driven gear
- Servo assembly
- Valve body assembly, spacer plate, gaskets, throttle lever and bracket assembly, auxiliary valve body, TCC solenoid, switch and wiring.
- Converter to flexplate bolts.
- Oil pan and/or gasket, strainer assembly and "O" ring.
- Pressure Regular Valve.
- Rear Oil Seal.

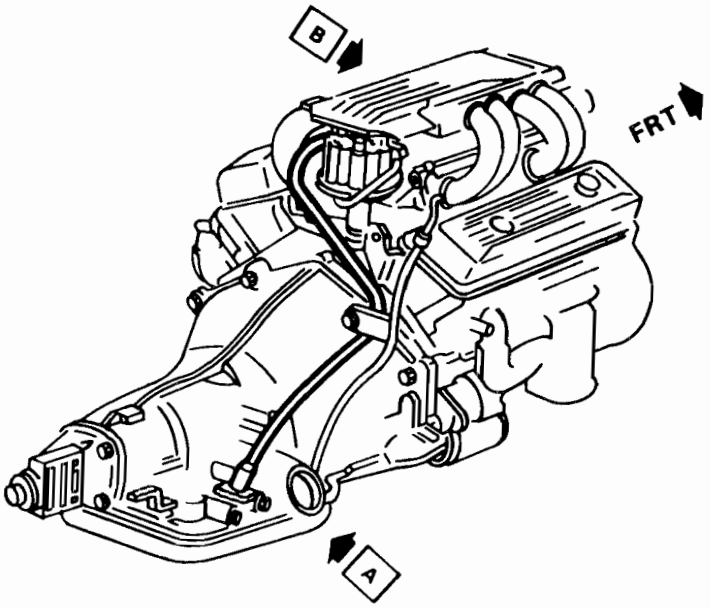
SERVO ASSEMBLY

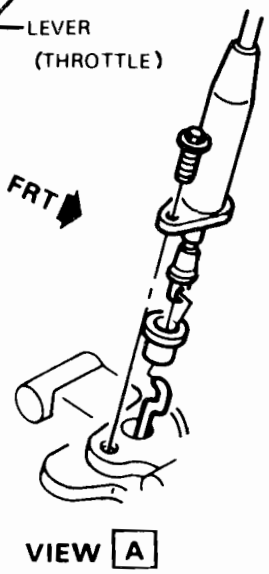
Remove or Disconnect (Fig. 6)

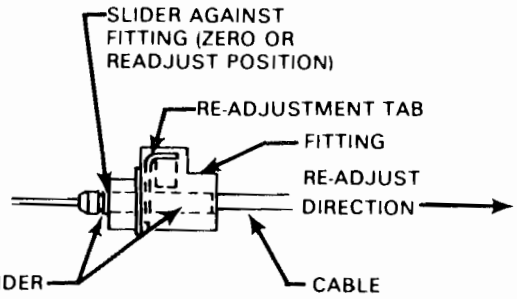
Tool Required:
J 29714

1. Negative battery cable.
2. Raise car and suitably support, see Section 0A.
   Upper and lower underbody braces on vehicles with a convertible top.
3. Complete exhaust system as an assembly:
   - A.I.R. pipe at the converter
   - A.I.R. pipe clamps at exhaust manifold
   - Oxygen sensor wire connector
   - Exhaust hanger at driveline support beam
   - Hanger bolts at mufflers
   - Hanger bracket at converter
   - Exhaust pipes at manifolds
4. Support transmission
5. Driveline support beam, see Section 3D.
6. Propeller shaft, see Section 4A.
7. Two transmission oil pan bolts below servo cover.
8. Install J 29714 on oil pan and reinstall oil pan bolts.
9. Depress servo cover and remove retaining ring.
10. J 29714.









ADJUSTMENT PROCEDURE

1. AFTER INSTALLATION OF CABLE TO THE ENGINE BRACKET AND THROTTLE IDLER LEVER, CHECK TO ASSURE THAT THE CABLE SLIDER IS IN THE ZERO OF FULLY RE-ADJUSTED POSITION (IF NOT, REFER TO THE RE-ADJUSTMENT PROCEDURE).
2. ROTATE THE THROTTLE IDLER LEVER TO THE "FULL TRAVEL STOP" POSITION.
3. SLIDER MUST MOVE (RATCHET) TOWARD LEVER WHEN LEVER IS ROTATED TO "FULL TRAVEL STOP POSITION".
4. RELEASE LEVER

RE-ADJUSTMENT PROCEDURE

1. DEPRESS AND HOLD METAL RE-ADJUSTMENT TAB.
2. MOVE SLIDER BACK THROUGH FITTING IN DIRECTION AWAY FROM THROTTLE IDLER LEVER UNTIL SLIDER STOPS AGAINST FITTING.
3. RELEASE RE-ADJUSTMENT TAB.
4. REPEAT STEP 2 & 3 OF ADJUSTMENT PROCEDURE.

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Fig. 5 T.V. Cable

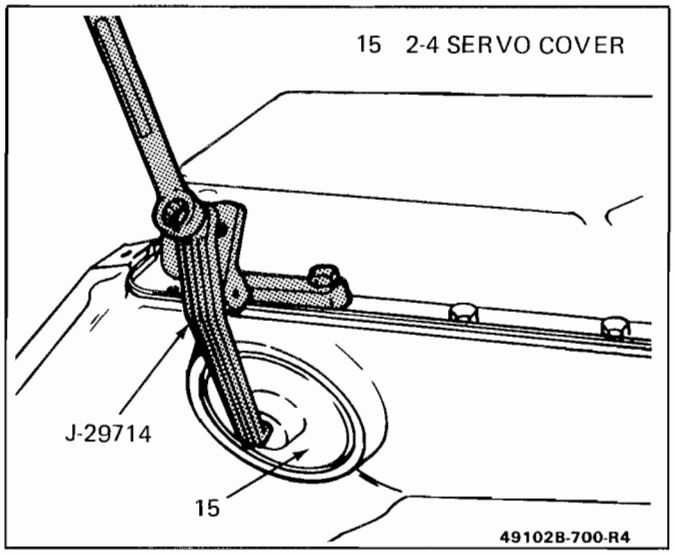


Fig. 6 Servo Cover

11. Cover and seal ring.
    - Seal may stick in case.
12. Servo piston and bore apply pin assembly.

Inspect

- Refer to the Unit Repair Section for disassembly and inspection procedures.

Install or Connect

1. Servo piston and bore apply pin assembly.
2. Seal ring and cover.
3. J 29714 and two oil pan bolts.
4. Depress cover and install retaining ring.
5. Remove J 29714 and bolts.
6. Oil pan bolts.
    - 20 N·m (15 lbs. ft.)
7. Propeller shaft, see Section 4A.
8. Driveline support beam, see Section 3D.
9. Exhaust system, see Section 6F.
10. Lower car.
11. Negative battery cable.

Adjust

- Fluid level, see Section 7A.
    - Dexron II Automatic Transmission Fluid.

SPEEDOMETER DRIVE GEAR

Remove or Disconnect (Fig. 7)

1. Negative battery cable.
2. Raise car and suitably support, see Section 0A. Upper and lower underbody braces on vehicles with a convertible top.
3. Complete exhaust system as an assembly:
    - A.I.R. pipe at converter
    - A.I.R. pipe clamp at exhaust manifold
    - Oxygen sensor wire connector
    - Exhaust hanger at driveline support beam
    - Hanger bolts at mufflers
    - Hanger bracket at converter
    - Exhausts pipes at manifolds
4. Support transmission.
5. Driveline support beam, see Section 3D.
6. Propeller Shaft, see Section 4A.
7. Speedometer wire connector from transmission.
8. Speedometer driven gear and sleeve assembly.
9. Extension housing bolts.
10. Extension housing.
11. Speedometer drive gear and retaining clip.

Install or Connect (Fig. 8)

1. Speedometer drive gear and retaining clip.
2. Seal ring and extension housing.
3. Extension housing bolts.
    - 34 N·m (26 lbs. ft.).
4. Propeller Shaft, see Section 4A.
5. Driveline support beam, see Section 3D.
6. Speedometer driven gear and sleeve assembly.
7. Speedometer wire connector.
8. Exhaust system, see Section 6F.
9. Lower car.
10. Negative battery cable.

Adjust

- Fluid level, see Section 7A.
    - Dexron II Automatic Transmission Fluid

SPEEDOMETER DRIVEN GEAR

Remove or Disconnect (Fig. 7)

1. Raise car and suitably, see Section 0A.
2. Speedometer wire connector.
3. Speedometer driven gear and sleeve assembly.

Install or Connect

1. Speedometer driven gear and sleeve assembly.
    - Use new "O" ring on sleeve.
2. Speedometer wire connector.
3. Lower car.

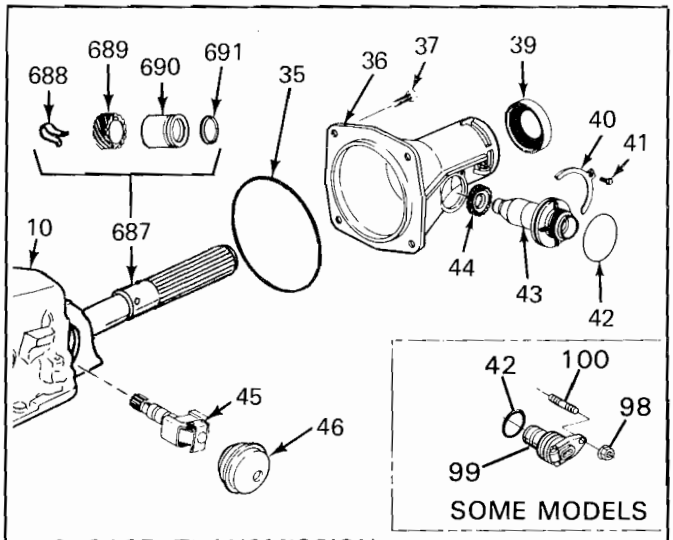
Adjust

- Fluid level, see Section 7A
    - Dexron II Automatic Transmission Fluid

GOVERNOR

Remove or Disconnect (Fig. 7)

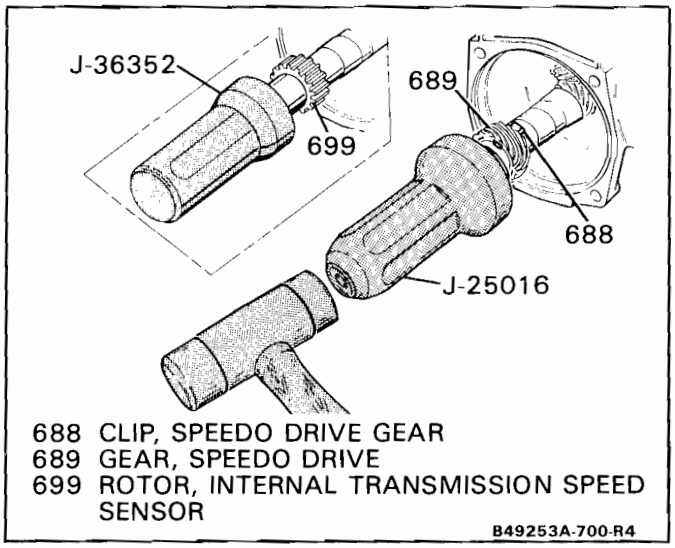
1. Negative battery cable.
2. Raise car and suitably support, see Section 0A. Upper and lower underbody braces on vehicles with a convertible top.
3. Complete exhaust system as an assembly:
    - A.I.R. pipe at converter
    - A.I.R. pipe clamp at exhaust manifold
    - Oxygen sensor wire connector
    - Exhaust hanger at driveline support beam
    - Hanger bolts at mufflers



10 CASE, TRANSMISSION
35 SEAL, CASE EXTENSION TO CASE
36 EXTENSION, CASE
37 BOLT, CASE EXTENSION TO CASE
39 SEAL ASSEMBLY, CASE EXTENSION OIL
40 RETAINER, SPEEDO DRIVEN GEAR FITTING
41 BOLT & WASHER ASSEMBLY
42 SEAL, "O" RING (SPEEDO FITTING TO CASE EXTENSION)
43 FITTING ASSEMBLY, SPEEDO DRIVEN GEAR
44 GEAR, SPEEDO DRIVEN
45 GOVERNOR ASSEMBLY
46 COVER, GOVERNOR
98 NUT, FLANGED HEX
99 SPEED SENSOR, INTERNAL TRANSMISSION
100 STUD, DOUBLE END
687 SHAFT, OUTPUT
688 CLIP, SPEEDO DRIVE GEAR
689 GEAR, SPEEDO DRIVE
690 SLEEVE, OUTPUT SHAFT — NOT USED ON
691 SEAL, OUTPUT SHAFT — ALL MODELS

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Fig. 7 Speedometer Drive/Driven Gears



688 CLIP, SPEEDO DRIVE GEAR
689 GEAR, SPEEDO DRIVE
699 ROTOR, INTERNAL TRANSMISSION SPEED SENSOR

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Fig. 8 Drive Gear

- Hanger bracket at converter
- Exhausts pipes at manifolds

4. Governor cover and "O" ring using a screwdriver.
   - Use extreme care not to damage cover and case.
5. Governor assembly.
6. Refer to the Unit Repair Section for disassembly and inspection procedures.

Install or Connect

1. Governor assembly.
2. Governor cover with a new "O" ring.
   - Apply sealant such as Loctite Cup Plug Sealant II or equivalent to the cover.
3. Exhaust system, see Section 6F.
4. Lower car.
5. Negative battery cable.

Adjust

- Fluid level, see Section 7A.
- Inspect for leaks at cover.

FILLER TUBE

Remove or Disconnect (Fig. 9)

1. Fluid level indicator.
2. Raise car and suitably support, see Section 0A.
3. Bolt retaining filler tube to transmission.
4. Loosen tube from transmission.
5. Lower car.
6. Pull tube out of car from the top.

Install or Connect

1. Filler tube.
2. Raise car.
3. Locate filler tube on transmission.
   - Use new filler tube seal.
4. Filler tube bolt to transmission.
   - 47 N·m (35 lbs. ft.)
5. Lower car.
6. Fluid level indicator.

Adjust

- Fluid level, see Section 7A.
- Inspect for leaks.

PRESSURE REGULATOR VALVE

Remove or Disconnect

1. Negative battery cable.
2. Raise car and suitably support, see Section 0A. Upper and lower underbody braces on vehicles with a convertible top.
3. Drain transmission oil pan.
4. Oil pan and screen.
5. Compress pressure regulator valve with small screwdriver.
6. Retaining ring and slowly release spring tension.

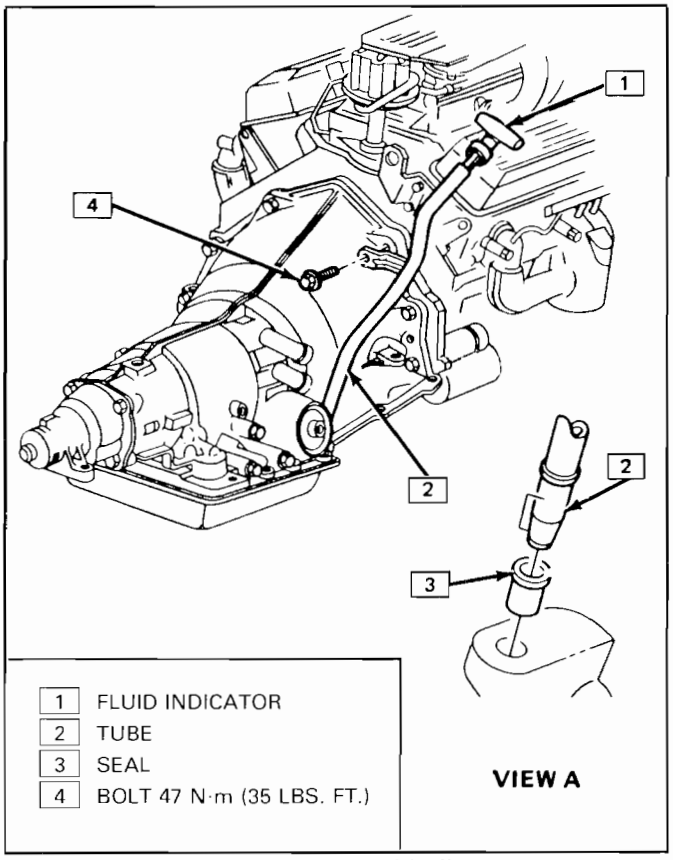


Fig. 9 Filler Tube and Indicator

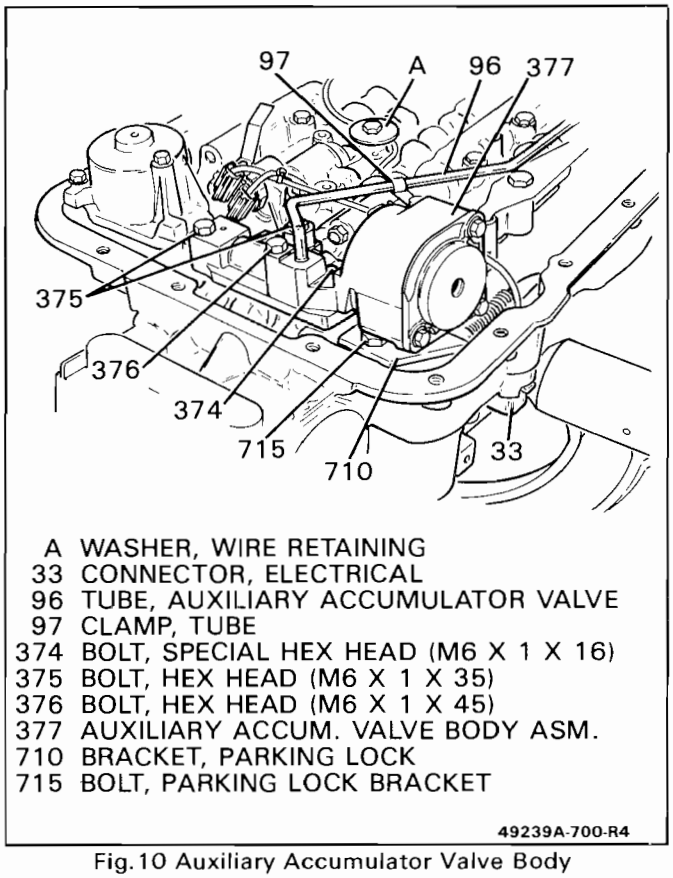


Fig. 10 Auxiliary Accumulator Valve Body

7. Pressure regulator bore plug, valve, spring and guide. Refer to the specific Unit Repair Section for inspection procedures.

Install or Connect

1. Pressure regulator valve assembly.
2. Compress valve and insert retaining ring.
3. Oil pan and screen, using a new gasket.
4. Lower car.
5. Negative battery cable.

Adjust

- Fluid level, see Section 7A.
  - Dexron II Automatic Transmission Fluid
  - Inspect for leaks

AUXILLARY VALVE BODY

Remove or Disconnect (Fig. 10)

1. Negative battery cable
2. Raise car and suitably support, see Section 0A. Upper and lower underbody braces on vehicles with a convertible top.
3. Place drain pan under transmission oil pan.
4. Oil pan bolts from the front and sides only.
5. Loosen rear bolts approximately (4) turns.

NOTICE: Do not damage case or oil pan sealing surfaces.

6. Lightly tap oil pan with rubber mallet or pry to allow fluid to drain.
7. Remaining oil pan bolts, oil pan and gasket.
8. Oil filter and "O" ring.
   - "0" ring may be stuck in case.
9. Tube clamp (97).
10. Tube (96).
11. Bolts (374 thru 376), auxiliary valve body (377), and check ball.

Inspect

- Refer to the Unit Repair Section for disassembly and inspection procedures.

Install or Connect

1. Check ball in valve body.
   - If necessary, use petroleum jelly to hold in place.
2. Auxiliary valve body to valve body with bolts (374 thru 376).
   - 11 N·m (8 lbs. ft.)
3. Tube (96)
4. Clamp (97)
5. New oil filter and "0"-ring.
   - Coat "0" with petrolatum.
6. Oil pan with new gasket.
   - All traces of old gasket material must be removed from case and pan.
7. Oil pan bolts.

- 20 N·m (15 lbs. ft.)

8. Lower car.
9. Negative battery cable

Adjust

- Fluid level, see Section 7A.
  - Dextron II Automatic Transmission Fluid
  - Inspect for leaks

VALVE BODY

Remove or Disconnect

1. Negative battery cable.
2. T.V. cable at throttle lever.
3. Raise car and suitably support, see Section 0A. Upper and lower underbody braces on vehicles with a convertible top.
4. Place drain pan under transmission oil pan.
5. Oil pan bolts from the front and sides.
6. Loosen rear oil pan bolts approximately 4 turns.

NOTICE: Do not damage transmission case or oil pan sealing surfaces.

7. Lightly tap oil pan with rubber mallet or pry to allow fluid to drain.
8. Remaining oil pan bolts, oil pan and gasket.
9. Oil filter and "O" ring.
   - "O" may be stuck in case.
10. Valve body bolts.
    - Manual control valve link from range selector inner lever.
    - Throttle lever bracket from T.V. link.
    - Spacer plate and check balls.

Clean

- Oil pan and case of gasket material.
- Valve body components.

Inspect

- Refer to the Unit Repair Section for disassembly and inspection procedures.

Install or Connect

1. Valve body, spacer, check balls and bolts as outlined in the Unit Repair Section.
2. New "O" ring seal and oil filter.
   - Coat "O" ring seal with petrolatum.
3. New gasket, oil pan and bolts.
   - 20 N·m (15 lbs. ft.)
4. Lower car.
5. Negative battery cable.

Adjust

- Fluid level, see Section 7A.
  - Dexron II Automatic Transmission Fluid
  - Inspect for leaks
- T.V. cable, see Fig. 5.

REAR OIL SEAL

Remove or Disconnect

Tool Required:
J 21426 Seal Installer

1. Negative battery cable.
2. Raise car and suitably support, see Section 0A. Upper and lower underbody braces on vehicles with a convertible top.
3. Complete exhaust system as an assembly:
   - A.I.R. pipe at converter
   - A.I.R. pipe clamp at exhaust manifold
   - Oxygen sensor wire connector
   - Exhaust hanger at driveline support beam
   - Hanger bolts at mufflers
   - Hanger bracket at converter
   - Exhausts pipes at manifolds
4. Support transmission.
5. Driveline support beam, see Section 3D.
6. Propeller shaft, see Section 4A.
7. Pry out lip seal with a suitable tool.

Install or Connect

1. Coat outer casing of new lip oil seal with non-hardening sealer and tap in place with J 21426.
2. Propeller shaft, see Section 4A.
3. Driveline support beam, see Section 3D.
4. Exhaust system, see Section 6F.
5. Lower car.
6. Negative battery cable.

Adjust

- Fluid level.
  - Dexron II Automatic Transmission Fluid
  - Inspect for leaks

OIL COOLER LINES AND/OR FITTINGS

Fig. 11

If replacement of transmission cooler lines is required, use only double wrapped and brazed steel tubing meeting GM specification 123M or equivalent. Tubing should be double flared.

NOTICE: Allow sufficient clearance around cooler lines to prevent damage or wear which may cause fluid loss.

TRANSMISSION ASSEMBLY

A pressure test should be performed before transmission removal to aid in diagnosis.

Tools Required:
J 21366 Torque Converter Holding Fixture

Remove or Disconnect (Figs. 11 thru 14)

1. Negative battery cable.
2. Air cleaner.
3. T.V. cable at throttle lever.

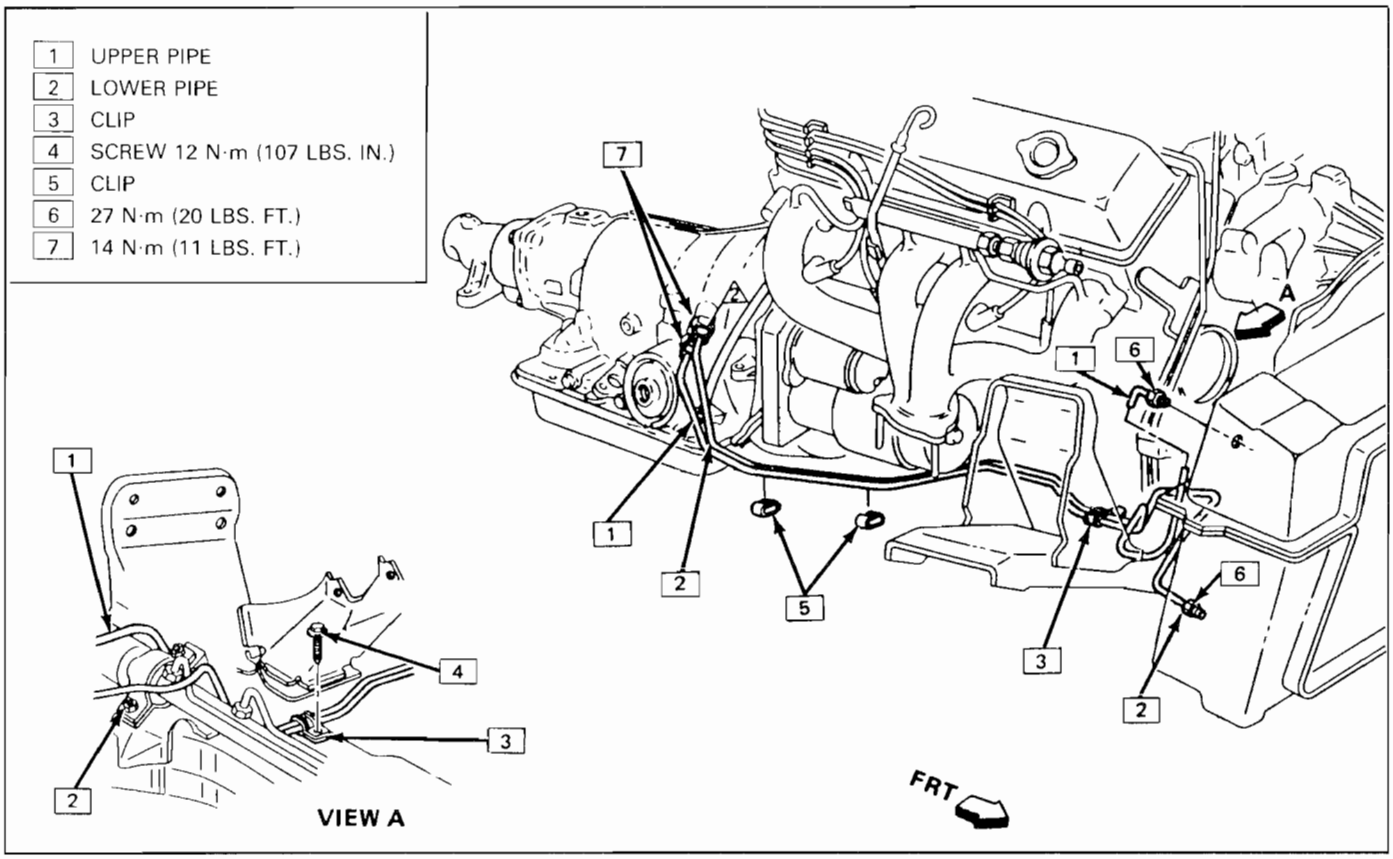


Fig. 11 Oil Cooler Pipes

4. Transmission fluid level indicator.
5. Raise car and suitably support, see Section 0A. Upper and lower underbody braces on vehicles with a convertible top.
6. Complete exhaust system as an assembly:
   - A.I.R. pipe at converter
   - A.I.R. pipe clamp at exhaust manifold
   - Oxygen sensor wire connector
   - Exhaust hanger at driveline support beam
   - Hanger bolts at mufflers
   - Hanger bracket at converter
   - Exhausts pipes at manifolds
7. Support transmission.
8. Driveline support beam, see Section 3D.
9. Propeller Shaft, see Section 4A.
10. Speedometer wire connector.
11. Shift control cable.
12. Electrical leads at transmission.
13. Converter cover.
    - Mark flywheel to torque converter.
14. Torque converter bolts.
15. Oil cooler pipes at transmission.
16. T.V. cable at transmission.
17. Transmission to engine bolts.
18. Transmission.
    - Install J 21366 and remove transmission.

Clean

Transmission oil cooler and lines should be flushed with J 35944 or equivalent whenever the transmission has been removed for overhaul or replacement of the torque converter, pump or case. Follow the tool manufacturer instruction for flushing the oil cooler and lines.

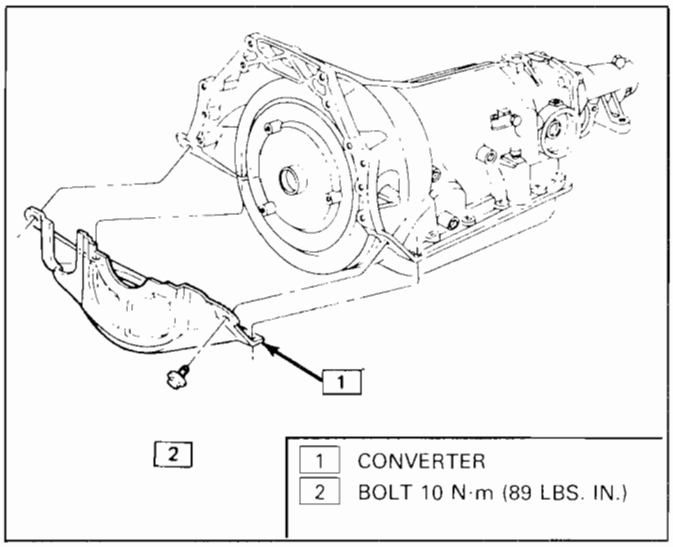


Fig. 12 Converter Cover

Install or Connect

1. Attach transmission jack.
2. Raise transmission.
   - Remove J 21366
3. Transmission to engine bolts.

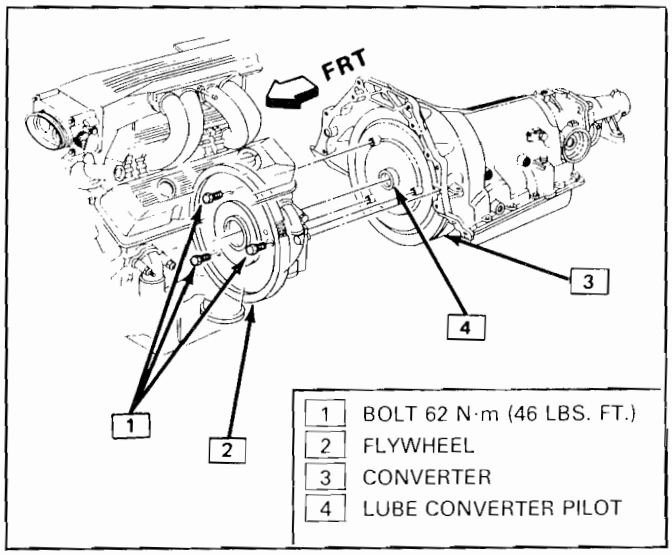


Fig. 13 Converter to Flywheel

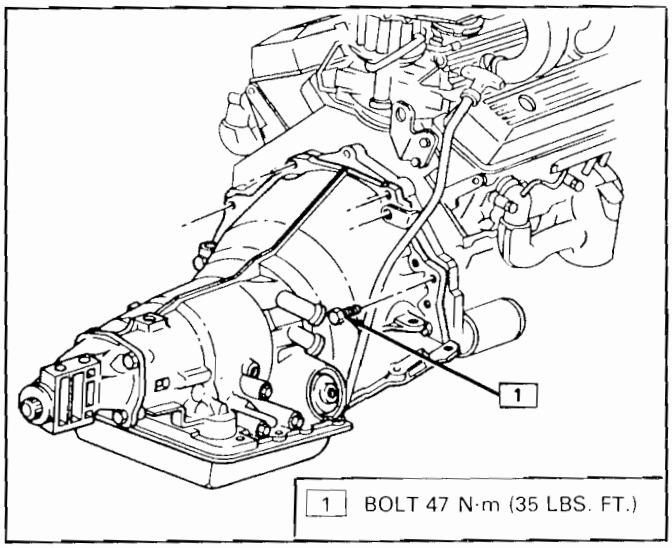


Fig. 14 Trans. to Engine

- 47 N·m (35 lbs. ft.)

4. Torque converter to flywheel bolts.
   - 62 N·m (46 lbs. ft.)
   - Align marks made during disassembly.
5. Converter cover.
   - 10 N·m (89 lbs. in.)
6. Oil cooler lines.
7. T.V. cable.
8. Electrical leads at transmission.
9. Speedometer wire connector.
10. Shift control cable.
11. Propeller shaft, see Section 4A.
12. Driveline support beam, see Section 3D.
13. Exhaust system, see Section 6F.
14. Lower car.
15. T.V. cable at throttle lever.
16. Negative battery cable.
17. Air cleaner.

Adjust

- Shift control cable.
- T.V. cable
- Fluid level, see Section 7A
  - Dexron II Automatic Transmission Fluid

SECTION 700-R4

MD8

AUTOMATIC TRANSMISSION HYDRAULIC DIAGNOSIS

CONTENTS

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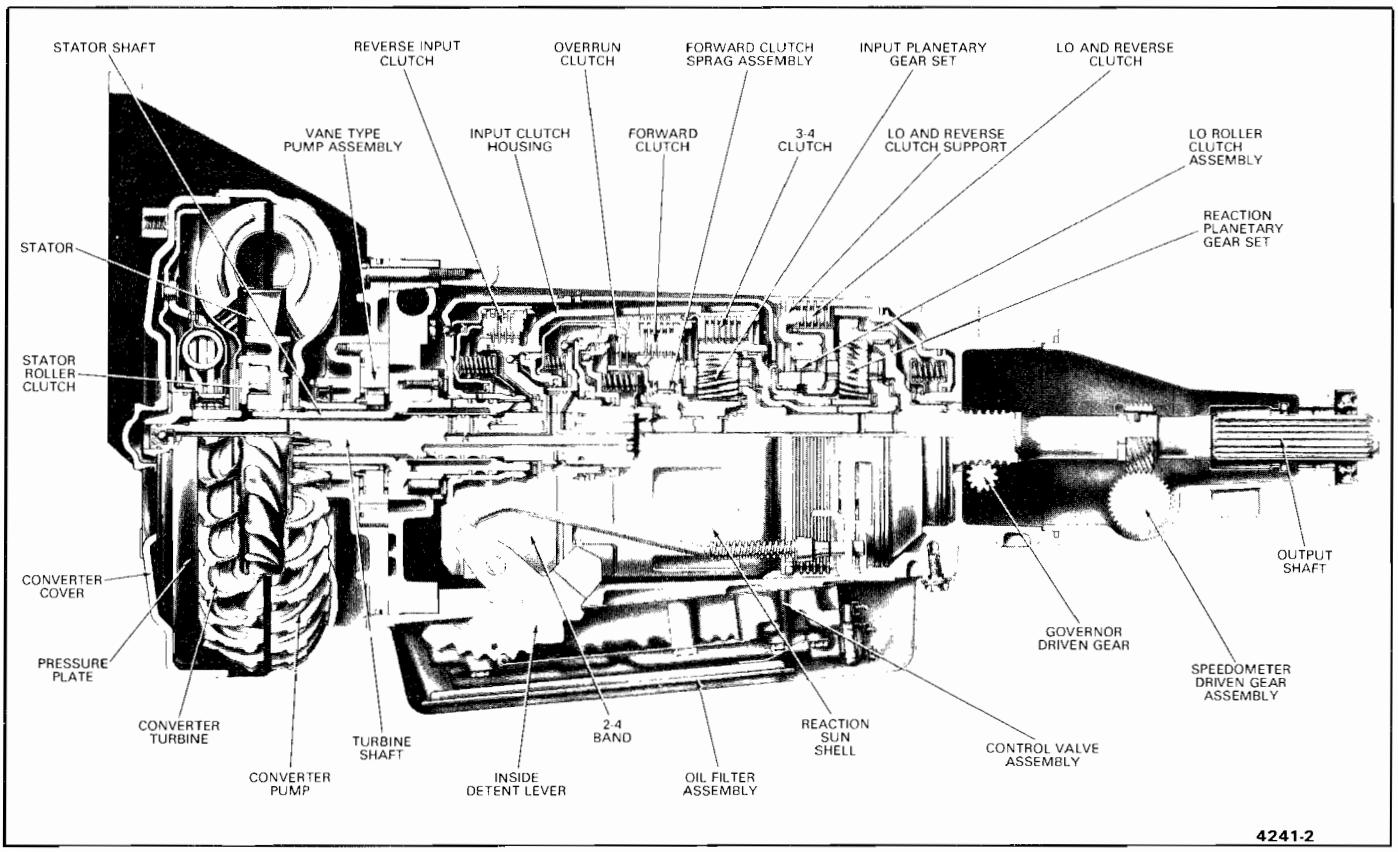


Figure 1 THM 700-R4 Transmission

GENERAL DESCRIPTION

The THM 700-R4 is a fully automatic transmission for rear wheel drive vehicles which provides four forward gear ranges and a reverse.

The major components of this transmission are:

- Torque Converter Clutch Asm.
- Vane Type Oil Pump
- 2-4 Band Asm.
- Five Multiple Disc Clutches
- Two Planetary Gear Sets
- One Sprag Clutch
- One Roller Clutch
- Valve Body Asm.

The oil pressure and shift points are controlled by throttle opening via a throttle valve cable. (See Section 7A2 for T.V. cable information).

The transmission can be operated in any one of the following seven modes:

P - Park position prevents the vehicle from rolling either forward or backward. (For safety reasons the parking brake should be used in addition to the park position).

R - Reverse allows the vehicle to be operated in a rearward direction.

N - Neutral allows the engine to be started and operated without driving the vehicle. If necessary this position may be selected if the engine must be restarted with the vehicle moving.

D - Overdrive is used for all normal driving conditions. It provides four gear ratios plus converter clutch operation. Downshifts are available for safe passing by depressing the accelerator.

D - Drive position is used for city traffic, hilly terrain, and trailer towing. It provides three gear ranges. Again, downshifts are available by depressing the accelerator.

2 - Manual second is used to provide acceleration and engine braking. This range may be selected at any vehicle speed.

1 - Manual Lo is used to provide maximum engine braking. This range may also be selected at any vehicle speed.

DIAGNOSIS INFORMATION

ROAD TEST PROCEDURE

- Perform the road test following the sequence given
- MPH (KPH) shift points will vary with actual throttle position and driver habits
- Compare the results of the test with speed shift chart information. Use these results with the diagnosis information in the specific Automatic Transmission Unit Repair Section the evaluate the transmission.
- This test should only be performed when traffic and road conditions permit
- Observe all traffic safety regulations

Garage Shift Check

1. Start engine
2. Depress brake pedal
3. Move gear selector:
   - "Park" (P) to "Reserve" (R)
   - "Reverse" (R) to "Neutral" (N) to "Drive" (D)

   Gear selections should be immediate and not harsh.

Upshifts and Torque Converter Clutch (TCC) Apply (Figure 2)

With gear selector in "Overdrive" (D)

1. Accelerate using a steady increasing throttle pressure
2. Note the shift speed point gear engagements for:
   - 2nd gear
   - 3rd gear
   - Overdrive
3. Note the speed shift point for TCC apply. This should occur while in third gear or overdrive. If the apply is not noticed, refer to the Preliminary Torque Converter Clutch Diagnosis information contained in this section of the Service Manual.

Important

The torque converter clutch will not engage if engine coolant has not reached a minimum operating temperature of approximately 54°C (130°F).

Part Throttle Detent Downshift

At vehicle speeds of 40-55 MPH (64-88 KPH) quickly depressed the accelerator to a half open position and observe:

- TCC releases
- Transmission downshift to 3rd gear immediately

Full Throttle Detent Downshift

At vehicle speeds of 40-55 MPH (64-88 KPH) quickly depress the accelerator to a wide open position and observe:

- TCC releases
- Transmission downshifts to 3rd gear immediately

Manual Downshift

1. At vehicle speeds of 40-55 MPH (64 to 88 KPH) release the accelerator pedal while moving the gear selector to "Third" gear (D) and observe:
   - TCC release
   - Transmission downshift to 3rd gear should be immediate
   - Engine should slow vehicle down
2. Move gear selector to "Overdrive" and accelerate to 40-45 MPH (64-72 KPH). Release the accelerator pedal while moving the gear selector to "Second" gear (2) and observe.
   - TCC release
   - Downshift to second gear should be immediate
   - Engine should slow vehicle down
3. Move gear selector to "Overdrive" (D) and accelerate to 25 MPH (40 KPH). Release the accelerator pedal while moving the gear selector to "First" gear (1) and observe:
   - TCC release
   - Transmission downshift to 1st gear should be immediate
   - Engine should slow vehicle down

Coastdown Downshift

1. With the gear selector in "Overdrive" (D) accelerate to 4th gear with TCC applied.
2. Release the accelerator pedal and lightly apply the brakes to observe:
   - TCC release
   - Shift points for downshifts.

Manual Gear Range Selection

MANUAL THIRD (D)

1. With vehicle stopped, place gear selector in "Third" (D) and accelerate to observe:

- The first to second gear shift point
- The second to third gear shift point

MANUAL SECOND (2)

2. With vehicle stopped, place gear selector in "Second" (2) and accelerate to observe:
   - The first to second gear shift point
3. Accelerate to 25 MPH (40 KPH) and observe:
   - That a second to third gear shift does not occur
   - That TCC does not engage

MANUAL FIRST (1)

1. With vehicle stopped, place gear selector in "First" (1) and accelerate to 15 MPH (24 KPH) and observe:
   - That no upshift occurs
   - That TCC does not engage

REVERSE

1. With vehicle stopped, place gear selector in "Reverse" (R) and slowly accelerate to observe reverse gear operation.
   All possible throttle positions and corresponding MPH shift point information has not been provided.

TRANSMISSION PRESSURE CHECK PROCEDURE

Inspect

- Fluid level
- TV cable adjustment
- Manual linkage
- Engine mechanical, emissions, electrical and fuel delivery systems

Install or Connect (Figure 3)

- Oil pressure gage
- Tachometer

1987 "THM 700-R4" SHIFT SPEED CHART

MODEL	1-2 MIN THROTTLE	2-3 MIN THROTTLE	3-4 MIN THROTTLE	4-3 PART THROTTLE	3-2 PART THROTTLE	4-3 COAST DOWN	3-2 COAST DOWN	2-1 COAST DOWN
FAM, MAM, MFM, MMM, MRM, MXM	12-15	13-24	33-55 +	55 +	38-55 +	28-54	17-28	11-14
MCM, MTM, PRM	9-13	16-27	32-55	55 +	31-48	27-53	14-22	8-12
MDM, MKM, MUM, TJM, TKM	13-16	22-30	37-55 +	55 +	42-55 +	32-55	19-27	12-14
MHM, PAM, PBM, PCM, TNM, TRM	9-11	17-24	28-47	55 +	27-45	25-44	14-22	8-10
MPM, MWM, MZM, TUM, TXM	11-14	19-26	33-51	55 +	37-55	28-49	16-24	10-13
TAM, TBM	9-11	15-22	23-51	52-55 +	27-51	20-47	11-20	8-10
TSM	8-10	16-22	32-47	55 +	26-55	26-43	13-20	7-9
YAM	9-10	13-18	27-48	55 +	25-55 +	21-43	10-16	8-9
YCM, YDM	11-12	15-22	32-55 +	55 +	30-55 +	24-51	12-18	9-11
YFM	11-14	18-25	31-54	55 +	28-51	26-51	15-23	10-13
YKM	10-12	19-25	31-48	55 +	31-52	27-45	15-23	9-11
YLM	10-12	16-23	32-47	55 +	31-47	28-45	12-19	9-11
YMM	9-10	13-19	24-44	55 +	22-52	18-38	10-16	8-9
YPM	11-13	19-26	28-43	55 +	35-55	25-41	16-24	10-12
YSM	10-12	15-22	31-55	55 +	29-55 +	24-50	12-18	9-11
YTM	12-14	19-25	36-55	55 +	38-55 +	31-53	15-23	11-13
YWM	8-9	12-17	24-44	55 +	23-53	19-39	9-14	7-9
YXM	10-12	16-27	35-52	55 +	36-54	30-49	13-23	9-11
YZM	11-13	13-24	34-46	55 +	36-53	30-44	10-20	10-12

NOTES:
1. ALL SPEEDS INDICATED ARE IN MILES PER HOUR. CONVERSION TO KPH = MPH x 1.609.
2. SHIFT POINTS WILL VARY SLIGHTLY DUE TO ENGINE LOADS AND VEHICLE OPTIONS.
3. SPEEDS LISTED WITH + EXCEED 55 MPH.

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Figure 2 Speed Shift Chart

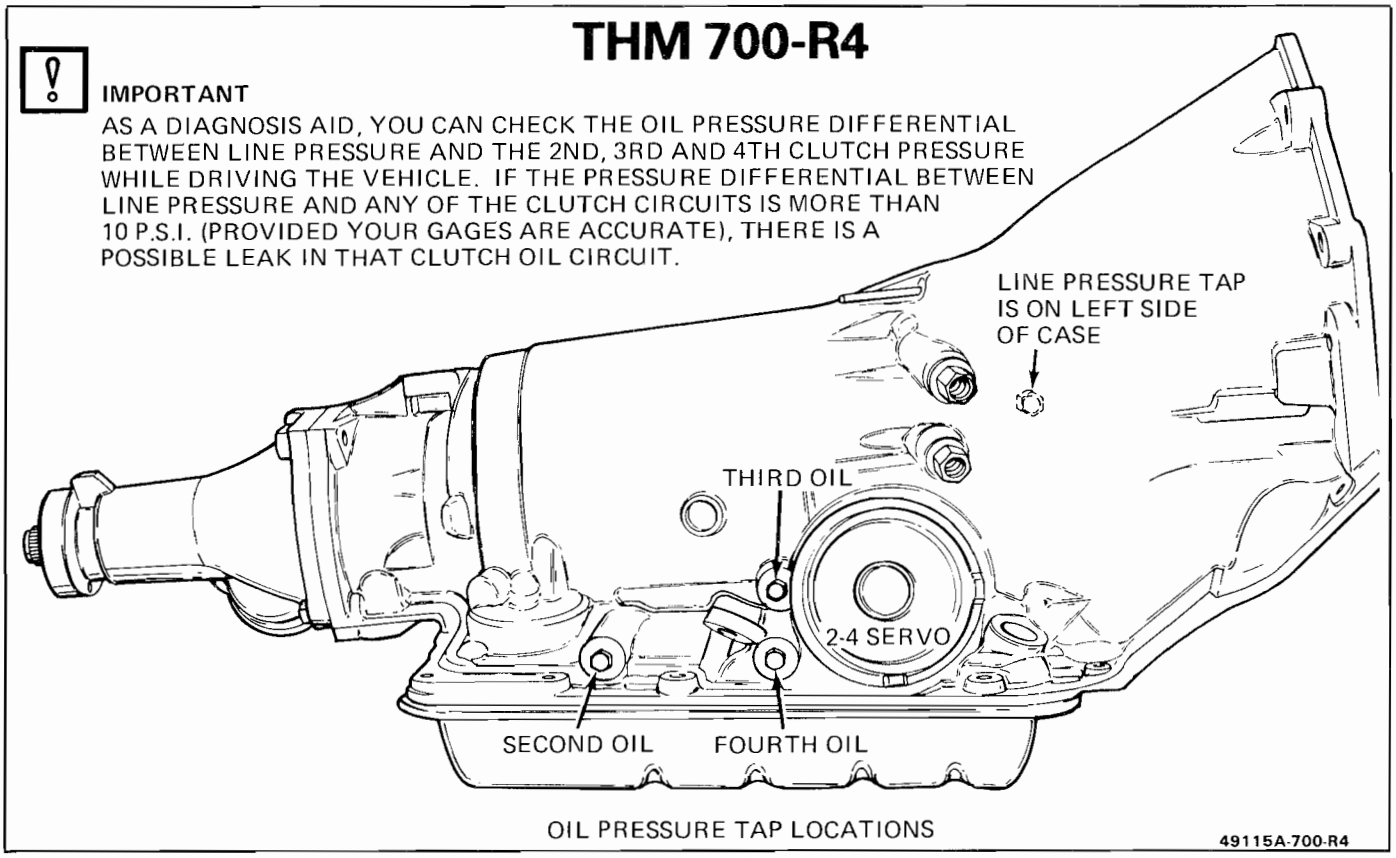
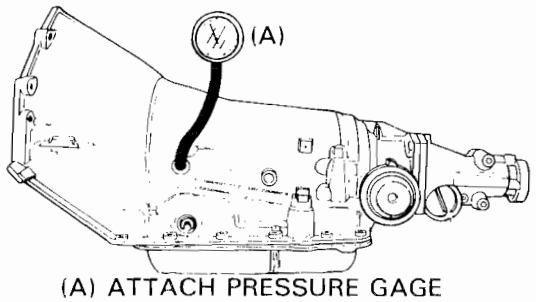


Figure 3 Oil Pressure Tap Locations

OIL PRESSURE CHECK INFORMATION

PRELIMINARY CHECK PROCEDURE

- CHECK TRANSMISSION OIL LEVEL
- CHECK AND ADJUST T.V. CABLE
- CHECK OUTSIDE MANUAL LINKAGE AND CORRECT
- CHECK ENGINE TUNE
- INSTALL OIL PRESSURE GAGE
- CONNECT TACHOMETER TO ENGINE
- CHECK OIL PRESSURE AS FOLLOWS:



(A) ATTACH PRESSURE GAGE

Minimum T.V. Line Pressure Check
Set the T.V. cable to specification; and with the brakes applied, take the line pressure readings in the ranges and at the engine r.p.m.'s indicated in the chart below.

Full T.V. Line Pressure Check
Full T.V. line pressure readings are obtained by tying or holding the T.V. cable to the full extent of its travel; and with the brakes applied, take the line pressure readings in the ranges and at the engine r.p.m.'s indicated in the chart below.

***NOTICE** Total running time for this combination not to exceed 2 minutes.

CAUTION Brakes must be applied at all times.

AUTOMATIC TRANSMISSION OIL PRESSURES

RANGE	MODEL	NORMAL OIL PRESSURE AT MINIMUM T.V.		NORMAL OIL PRESSURE AT FULL T.V.	
		kPa	PSI	kPa	PSI
PARK, NEUTRAL, OVERDRIVE & MANUAL 3RD @ 1000 RPM	YSM	384-444	56-64	994-1277	144-185
	YLM, YTM	384-444	56-64	818-1040	119-151
	YMM	451-515	65-75	1115-1430	162-207
	YXM	451-515	65-75	840-1053	122-153
	MCM, MHM, MTM, PAM, PBM, PCM, PRM, TAM, TBM, TNM, TRM, YFM	451-515	65-75	844-1068	122-155
	FAM, MAM, MDM, MFM, MKM, MMM, MPM, MRM, MSM, MUM, MWM, MXM, MZM, TJM, TKM, TUM, TXM	451-515	65-75	851-1063	123-154
	YPM	384-444	56-64	876-1333	127-193
	YKM	384-444	56-64	883-1129	128-164
	TSM	384-444	56-64	962-1237	139-179
	YAM, YCM, YDM, YWM, YZM	384-444	56-64	1049-1359	152-197
REVERSE @ 1000 RPM *@ 2000 RPM	YSM	632-729	92-106	*1634-2100	237-305
	YTM	632-729	92-106	*1345-1710	195-248
	YMM	742-846	108-123	*1834-2351	266-341
	YLM	632-729	92-106	*1380-1782	200-258
	YXM	742-847	108-123	*1381-1731	200-251
	MCM, MHM, MTM, PAM, PBM, PCM, PRM, TAM, TBM, TNM, TRM, YFM	742-847	108-123	*1388-1755	201-254
	FAM, MAM, MDM, MFM, MKM, MMM, MPM, MRM, MSM, MUM, MWM, MXM, MZM, TJM, TKM, TUM, TXM	742-847	108-123	*1399-1747	203-253
	YPM	632-730	92-106	*1441-2191	209-318
	YKM	632-730	92-106	*1452-1856	211-269
	TSM	632-730	92-106	*1581-2034	229-295
	YAM, YCM, YDM, YWM, YZM	632-730	92-106	*1724-2234	250-324
MANUAL 2ND & MANUAL LO @ 1000 RPM	TSM, YAM, YCM, YDM, YKM, YLM, YPM, YSM, YTM, YWM, YZM	1120-1293	162-187	1120-1293	162-187
	FAM, MAM, MCM, MDM, MHM, MKM, MMM, MPM, MRM, MSM, MTM, MUM, MWM, MXM, MZM, PAM, PBM, PCM, PRM, TAM, TBM, TJM, TKM, TNM, TRM, TUM, TXM, YFM, YMM, YXM	1127-1286	163-186	1127-1286	163-186

Line pressure is basically controlled by pump output and the pressure regulator valve. In addition, line pressure is boosted in Reverse, Second and Lo by the reverse boost valve.

Also, in the Neutral, Drive, Intermediate and Reverse positions of the selector lever, the line pressure should increase with throttle opening because of the T.V. system. The pressure is controlled by the T.V. cable, the throttle lever and bracket assembly and the T.V. link, as well as the control valve assembly.

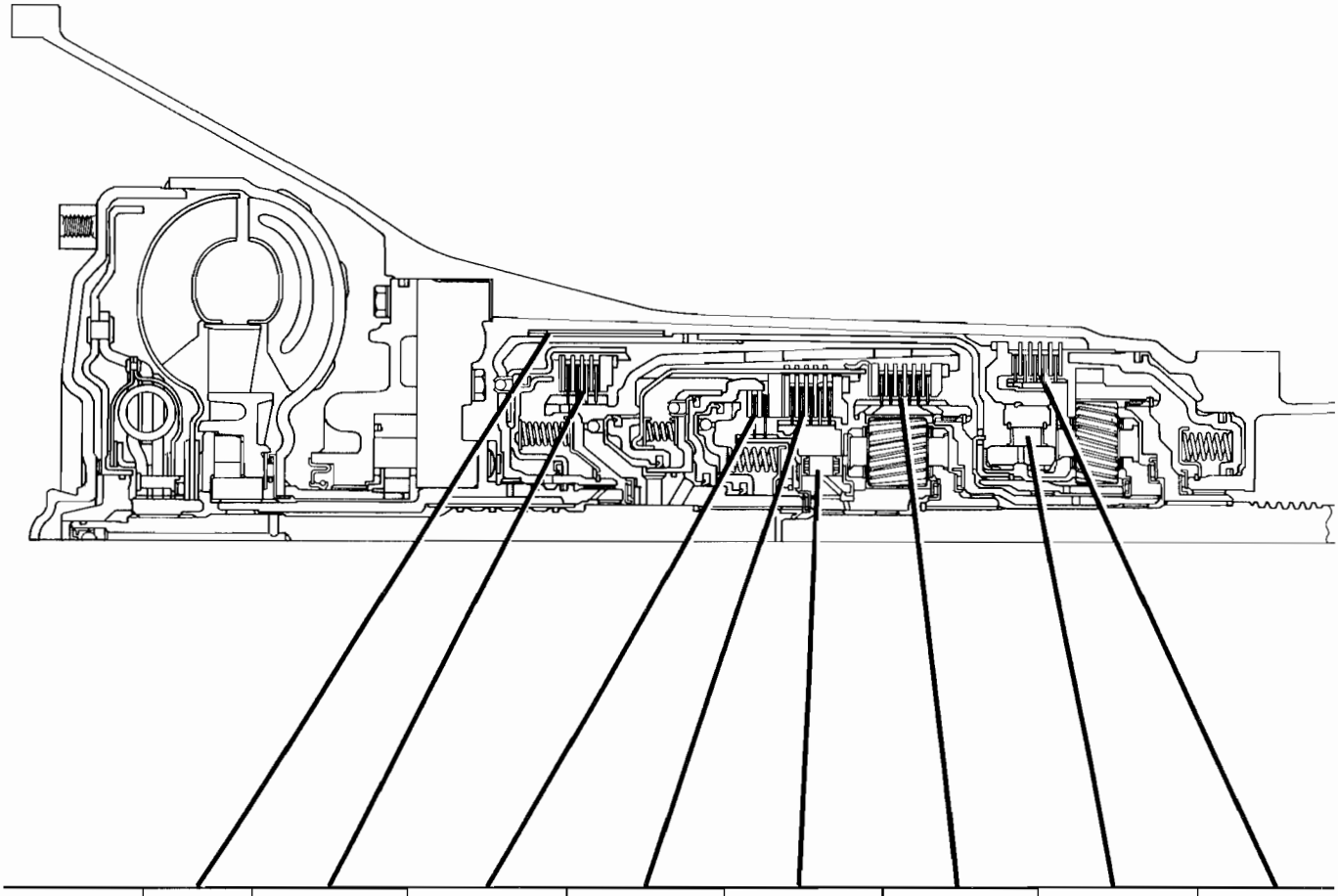
The main line pressure tap plug is located on the left side of the transmission above the outside manual lever.

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Figure 4 Oil Pressure Check Procedure

700 - GEAR RATIOS

FIRST	3.06	FOURTH	.70
SECOND	1.62	REVERSE	2.29
THIRD	1.00		



GEAR RANGE	2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO ROLLER CLUTCH	LO-REV. CLUTCH
1ST DR4				ON	ON		ON	
2ND DR4	ON			ON	ON			
3RD DR4				ON	ON	ON		
4TH DR4	ON			ON		ON		
3RD DR3			ON	ON	ON	ON		
2ND DR2	ON		ON	ON	ON			
1ST LO			ON	ON	ON		ON	ON
REV.		ON						ON

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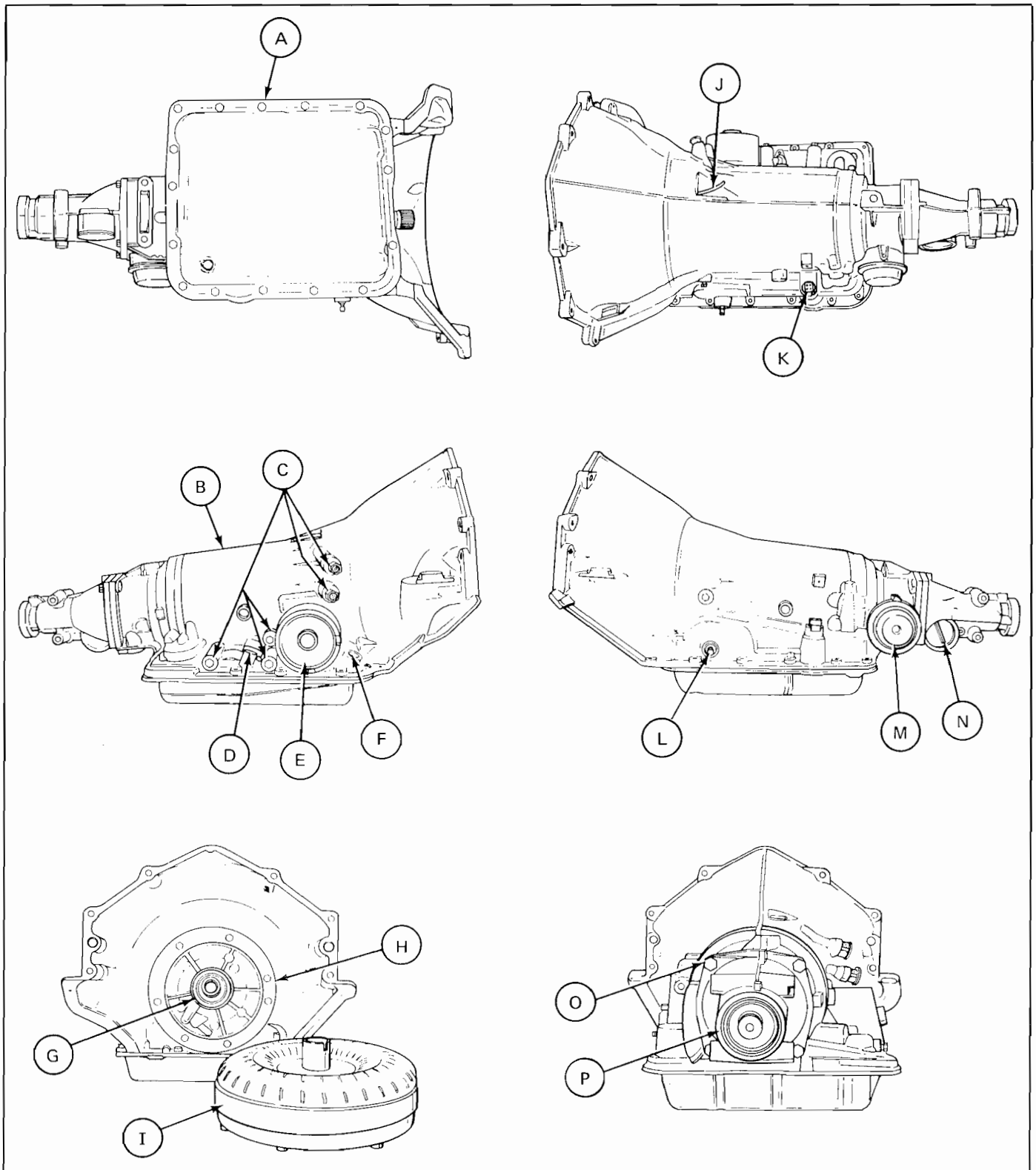
Figure 5 Clutch Application Chart

GENERAL DIAGNOSIS GUIDE

CONDITION	INSPECT COMPONENT	FOR CAUSE
OIL LEAK To Correctly Identify Oil Leaks, Perform the Following Procedure: • Clean all residual oil from the transmission with electramotive cleanser or equivalent. • Dust the transmission with leak tracing powder or spray foot powder. • Bring the engine to normal operating temperature. • Turn the engine off and let the vehicle set for thirty minutes. • Check for leaks.	• Oil Pan	– Low bolt torque. – Cut or damaged oil pan gasket.
	• T.V. Cable Connector	– Connector cocked and interfering with mount. – Connector cracked. – Seal missing, cut or damaged.
	• Fill Tube	– Fill tube cracked or damaged. – Seal missing, cut, or damaged.
	• Electrical Connector	– Electrical connector cracked. – Seal missing, cut or damaged.
	• Manual Shaft	– Manual shaft nicked or damaged. – Manual shaft seal assembly missing, cut or damaged.
	• Governor Cover	– Gaps in sealant. (Remove & Reseal.)
	• Speedo Fitting	– Low bolt torque. – Seal missing, cut or damaged.
	• Servo Cover	– Porosity. – Sharp edges on case cut "O" ring seal.
	• Cooler Fittings	– Low torque. – Cracked fitting.
	• Converter Assembly	– Hub or seam weld leak.
	• Vent	– Oil overfill. – Engine coolant in transmission oil.
	• Oil Pump Assembly	– Low bolt torque. – Cut or damaged oil pump to case seal. – Damaged seal. (Restricted drainback passage.) – Porosity.
	• Rear Extension	– Damaged extension to case seal. – Porosity. – Damaged oil seal assembly.

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Figure 6 Diagnosis Chart A



A OIL PAN
B CASE
C COOLER CONNECTORS & PLUGS
D T.V. CABLE SEAL
E SERVO COVER
F OIL FILL TUBE SEAL
G OIL PUMP SEAL ASSEMBLY
H OIL PUMP TO CASE SEAL
I CONVERTER
J VENT
K ELECTRICAL CONNECTOR SEAL
L MANUAL SHAFT SEAL
M GOVERNOR COVER
N SPEEDO SEAL
O EXTENSION TO CASE SEAL
P EXTENSION OIL SEAL ASSEMBLY

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Figure 7 Possible Leak Points

CONDITION	INSPECT COMPONENT	FOR CAUSE
OIL PRESSURE HIGH OR LOW (Verify With Gage – Check Oil Level & Engine Tune.)	• Oil Pump Assembly	– Pressure regulator valve stuck. – Pressure regulator valve spring damaged. – Rotor guide omitted or misassembled. – Rotor cracked or broken. – T.V. valve, reverse boost valve or bushing stuck, damaged or incorrectly assembled. – Orifice hole in pressure regulator valve plugged. – Sticking slide or excessive rotor clearance. – Pressure relief ball not seated or damaged. – Porosity in pump cover or body. – Wrong pump cover. – Pump faces not flat.
	• Oil Filter	– Intake pipe restricted by casting flash. – Cracks in filter body or intake pipe. – "O" ring seal missing, cut or damaged.
	• T.V. Exhaust Ball	– Stuck or damaged.
	• Throttle Lever & Bracket Assy.	– Misassembled, binding or damaged.
	• Throttle Link	– Misassembled, binding or damaged.
	• Valve Body	– Manual valve scored or damaged. – Spacer plate or gaskets incorrect, misassembled or damaged. – Face not flat. – Throttle valve sticking. – Throttle valve sleeve rotated in bore or retaining pin not seated. – T.V. limit valve sticking. – Modulated downshift valve stuck. – Line bias valve stuck. – 2-3 shift valve stuck. – Check balls omitted or misassembled.
	• Case	– Case to valve body face not flat.
HIGH OR LOW SHIFT POINTS.	• T.V. Cable	– Binding or not correctly adjusted.
	• T.V. Exhaust Ball	– Stuck or damaged.
	• Throttle Lever & Bracket Assy.	– Misassembled, binding or damaged.
	• Oil Pump Assembly	– Stuck pressure regulator valve or T.V. boost valve. – Sticking pump slide.
	• Valve Body Assembly	– Sticking throttle valve or plunger. – Modulated T.V. up or down valves sticking. – T.V. limit valve sticking. – Spacer plate or gaskets misassembled, damaged or incorrect.

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Figure 8 Diagnosis Chart B

CONDITION	INSPECT COMPONENT	FOR CAUSE
1ST GEAR RANGE ONLY – NO UPSHIFT	• Governor Assembly	– Governor valve sticking. – Governor driven gear loose or damaged. – Governor driven gear retaining pin missing. – Nicks or burrs on output shaft. – Nicks or burrs on governor sleeve or case bore. – Governor support pin in case too long or short. – Governor weights or springs missing, binding or damaged.
	• Valve Body	– 1-2 shift valve sticking. – Spacer plate or gaskets mispositioned or damaged.
	• Case	– Case to valve body face not flat or damaged. – Governor screen restricted or damaged.
	• 2-4 Servo Assembly	– Restricted or blocked apply passages in case. – Nicks or burrs on servo pin or pin bore in case. – Missing or damaged piston or pin seals. – 4th servo piston in backwards.
	• 2-4 Band Assembly	– 2-4 band worn or damaged. – Band anchor pin not engaged.
SLIPS IN 1ST GEAR	• Forward Clutch Assembly	– Clutch plates worn. – Porosity or damage in forward clutch piston. – Forward clutch piston inner and outer seals missing, cut or damaged. – Input housing to forward clutch housing "O" ring seal missing, cut or damaged. – Damaged forward clutch housing. – Forward clutch housing retainer and ball assembly not sealing or damaged.
	• Input Housing & Shaft Assy.	– Turbine shaft seals missing, cut or damaged.
	• Valve Body	– Accumulator valve stuck. – Face not flat, damaged lands or interconnected passages. – Spacer plate or gaskets incorrect, mispositioned or damaged.
	• T.V. Cable	– Binding or broken.

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Figure 9 Diagnosis Chart C

CONDITION	INSPECT COMPONENT	FOR CAUSE
SLIPS IN 1ST GEAR (Continued)	• 1-2 Accumulator Piston Assy.	– Porosity in piston or 1-2 accumulator cover and pin assembly. – Damaged ring grooves on piston. – Piston seal missing, cut or damaged. – 1-2 accumulator cover gasket missing or damaged. – Leak between piston and pin. – Broken 1-2 accumulator spring.
	• Oil Pressure	– (See Causes of High or Low Oil Pressure.)
	• 2-4 Servo Assembly	– 4th servo piston in backwards.
1-2 SHIFT SPEED – HIGH OR LOW	• T.V. Cable	– Binding or broken. – Not correctly adjusted.
	• Governor Assembly	– (See 1st Gear Range Only – No Upshift.)
	• Throttle Lever & Bracket Assy.	– Misassembled, binding or damaged. – T.V. link missing, binding or damaged.
	• Valve Body	– T.V. exhaust check ball stuck. – T.V. plunger sticking. – Face not flat.
	• Oil Pump Assembly or Case	– Face not flat.
SLIPPING OR ROUGH 1-2 SHIFT	• Throttle Lever & Bracket Assy.	– Incorrectly installed or damaged. – T.V. cable broken or binding.
	• Valve Body Assembly	– Throttle valve sticking. – T.V. bushing turned in its bore. – 1-2 shift valve train stuck. – Gaskets or spacer plate incorrect, mis-positioned or damaged. – Line bias valve stuck. – Accumulator valve stuck. – T.V. limit valve stuck. – Face not flat.
	• 2-4 Servo Assembly	– Apply pin too long or too short. – Servo seals or "O" ring seals missing, cut or damaged. – Restricted or missing oil passages. – Servo bore in case damaged.
	• 2nd Accumulator	– Porosity in 1-2 accumulator housing or piston. – Piston seal or groove damaged. – Nicks or burrs in 1-2 accumulator housing. – Missing or restricted oil passage.

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Figure 10 Diagnosis Chart D

CONDITION	INSPECT COMPONENT	FOR CAUSE
SLIPPING OR ROUGH 1-2 SHIFT (Continued)	• 2-4 Band	– Worn or mispositioned.
	• Oil Pump Assembly or Case	– Faces not flat.
NO 2-3 SHIFT OR 2-3 SHIFT SLIPPING, ROUGH OR HUNTING	• Converter	– Internal damage.
	• Governor Assembly	– Valve stuck. – Drive gear retaining pin missing or loose. – Governor weights binding. – Governor drive gear damaged. – Governor support pin in case too long or too short.
	• Oil Pump	– Stator shaft sleeve scored or off location.
	• Valve Body	– 2-3 valve train stuck. – Accumulator valve stuck. – Spacer plate or gaskets incorrect, mispositioned or damaged. – Throttle valve stuck. – T.V. limit valve stuck.
	• Input Housing Assembly	– Clutch plates worn (3-4 or forward). – Excessive clutch plate travel. – Cut or damaged piston seals (3-4 or forward). – Porosity in 3-4 clutch housing or piston. – 3-4 piston check ball stuck, damaged or not sealing. – Restricted apply passages. – Forward clutch piston retainer and ball assembly not seating. – Sealing balls loose or missing.
	• Case	– 3rd accumulator retainer and ball assembly not seating.
	• 2-4 Servo Assembly	– 2nd apply piston seals missing, cut or damaged. – Servo pin seals missing, cut or damaged.
NO 3-4 SHIFT/SLIPPING OR ROUGH 3-4 SHIFT	• Governor	– Governor weights binding. – Governor valve stuck. – Governor drive gear retaining pin missing or loose. – Governor drive gear damaged. – Governor support pin in case too long or too short.
	• Oil Pump Assembly	– Faces not flat. – Pump cover retainer and ball assembly omitted or damaged.

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Figure 11 Diagnosis Chart E

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO 3-4 SHIFT/SLIPPING OR ROUGH 3-4 SHIFT (Continued)	• Valve Body Assembly	– Valves stuck. 2-3 shift valve train. Accumulator valve. Throttle valve. T.V. limit valve. 1-2 shift valve train. 3-2 control valve. – Manual valve link bent or damaged. – Spacer plates or gaskets incorrect, mispositioned or damaged.
	• 2-4 Servo Assembly	– Incorrect band apply pin. – Missing or damaged servo seals. – Porosity in pistons, cover or case. – Damaged piston seal grooves. – Plugged or missing orifice cup plug.
	• Case	– 3rd accumulator retainer and ball assembly leaking. – Porosity in 3-4 accumulator piston or bore. – 3-4 accumulator piston seal or seal grooves damaged. – Plugged or missing orifice cup plug. – Restricted oil passage.
	• Input Housing Assembly	– Refer to Slipping 2-3 Shift.
	• 2-4 Band Assembly	– Worn or misassembled.
NO REVERSE OR SLIPS IN REVERSE	• Input Housing Assembly	– 3-4 apply ring stuck in applied position. – Forward clutch not releasing. – Turbine shaft seals missing, cut or damaged.
	• Manual Linkage	– Not adjusted.
	• Oil Pump Assembly	– Retainer and Ball assembly missing or damaged. – Stator shaft seal rings or ring grooves damaged. – Stator shaft sleeve scored or damaged. – Reverse boost valve stuck, damaged or misassembled. – Cup plug missing. – Restricted oil passage. – Faces not flat. – Converter clutch apply valve stuck.
	• Valve Body Assembly	– 2-3 shift valve stuck. – Manual linkage not adjusted. – Spacer plate and gaskets incorrect, mispositioned or damaged.

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Figure 12 Diagnosis Chart F

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO REVERSE OR SLIPS IN REVERSE (Continued)	• Reverse Input Clutch	– Clutch plate worn. – Reverse input housing and drum assembly cracked at weld. – Clutch plate retaining ring out of groove. – Return spring assembly retaining ring out of groove. – Piston deformed or dished. – Seals cut or damaged. – Retainer and ball assembly not sealing. – Restricted apply passage.
	• Lo And Reverse Clutch	– Clutch plates worn. – Clutch plate retaining ring mispositioned. – Porosity in piston. – Seals damaged. – Return spring assembly retaining ring mispositioned. – Restricted apply passage.
	• Case	– Cover plate gasket missing or damaged. – Cover plate not torqued correctly. – Porosity.
NO PART THROTTLE OR DELAYED DOWNSHIFTS	• External Linkage	– Not adjusted.
	• 2-4 Servo Assembly	– Apply pin seal cut or damaged. – Servo cover retaining ring omitted or misassembled. – 4th apply piston damaged or misassembled. – Servo inner housing damaged or misassembled.
	• Governor Assembly	– Governor weights binding. – Governor valve stuck.
	• Valve Body Assembly	– Valves stuck. Throttle valve 3-2 control valve T.V. modulated downshift – T.V. sleeve turned in bore. – 4-3 sequence valve body channel blocked. – #5 check ball omitted from valve body.

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Figure 13 Diagnosis Chart G

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO OVERRUN BRAKING – MANUAL 3-2-1	• External Linkage	– Not adjusted properly.
	• Valve Body Assembly	– Valves stuck. 4-3 sequence valve Throttle valve – Check ball #3 mispositioned. – Spacer plate and gaskets incorrect, damaged or mispositioned.
	• Input Clutch Assembly	– Turbine shaft oil passages plugged or not drilled. – Turbine shaft seal rings damaged. – Turbine shaft sealing balls loose or missing. – Porosity in forward or overrun clutch piston. – Overrun piston seals cut or damaged. – Overrun piston check ball not sealing.
NO CONVERTER CLUTCH APPLY	• Electrical	– 12 volts not supplied to transmission. – Outside electrical connector damaged. – Inside electrical connector, wiring harness or solenoid damaged. – Electrical short (pinched solenoid wire). – Solenoid not grounded. – Incorrect or damaged pressure switches.
	• Converter	– Internal damage.
	• Oil Pump Assembly	– Converter clutch apply valve stuck or assembled backwards. – Converter clutch apply valve retaining ring mispositioned. – Pump to case gasket mispositioned. – Orifice cup plug plugged. – Solenoid "O" ring seal cut or damaged. – Orifice cup plug omitted from cooler in passage. – High or uneven bolt torque (pump body to cover).
	• Valve Body Assembly	– Valves stuck. Converter clutch shift valve Throttle valve
	• Input Housing And Shaft	– Turbine shaft "O" ring seal cut or damaged. – Turbine shaft retainer and ball assembly plugged.

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Figure 14 Diagnosis Chart H

CONDITION	INSPECT COMPONENT	FOR CAUSE
CONVERTER SHUDDER	• Torque Converter Assembly	– Internal damage.
	• Valve Body	– Converter clutch shift valve stuck.
	• Oil Pump Assembly	– Converter clutch apply valve stuck. – Restricted oil passage.
	• Oil Filter	– Crack in filter body. – Flash restricting filter neck. – "O" ring seal cut or damaged.
	• Miscellaneous	– Low oil pressure. – Engine not tuned properly.
	• Input Housing And Shaft Assy.	– Turbine shaft "O" ring cut or damaged. – Turbine shaft retainer and ball assembly damaged.
NO CONVERTER CLUTCH RELEASE	• Solenoid	– External ground.
	• Converter	– Internal damage.
	• Oil Pump Assembly	– Converter clutch apply valve stuck.
DRIVES IN NEUTRAL	• Forward Clutch	– Not releasing.
	• Manual Linkage	– Incorrectly adjusted. – Disconnected.
	• Case	– Face not flat. – Internal leakage.
2ND GEAR START (DRIVE RANGE)	• Governor Assembly	– Valve stuck. – Governor support pin too long or missing.
	• Forward Sprag Clutch	– Sprag assembly installed backwards.

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Figure 15 Diagnosis Chart I

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO PARK	• Parking Linkage	– Actuator rod assembly bent or damaged. – Actuator rod spring binding or improperly crimped. – Actuator rod not attached to inside detent lever. – Parking bracket damaged or not torqued properly. – Inside detent lever not torqued properly. – Detent roller mispositioned or not torqued properly. – Parking pawl binding or damaged.
RACHETING NOISE	• Parking Pawl	– Parking pawl return spring weak, damaged or misassembled.
OIL OUT THE VENT	• Oil Pump	– Chamfer in pump body rotor pocket too large.
	• Valve Body	– T.V. limit valve stuck.
VIBRATION IN REVERSE AND WHINING NOISE IN PARK	• Oil Pump	– Broken vane rings.

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Figure 16 Diagnosis Chart J

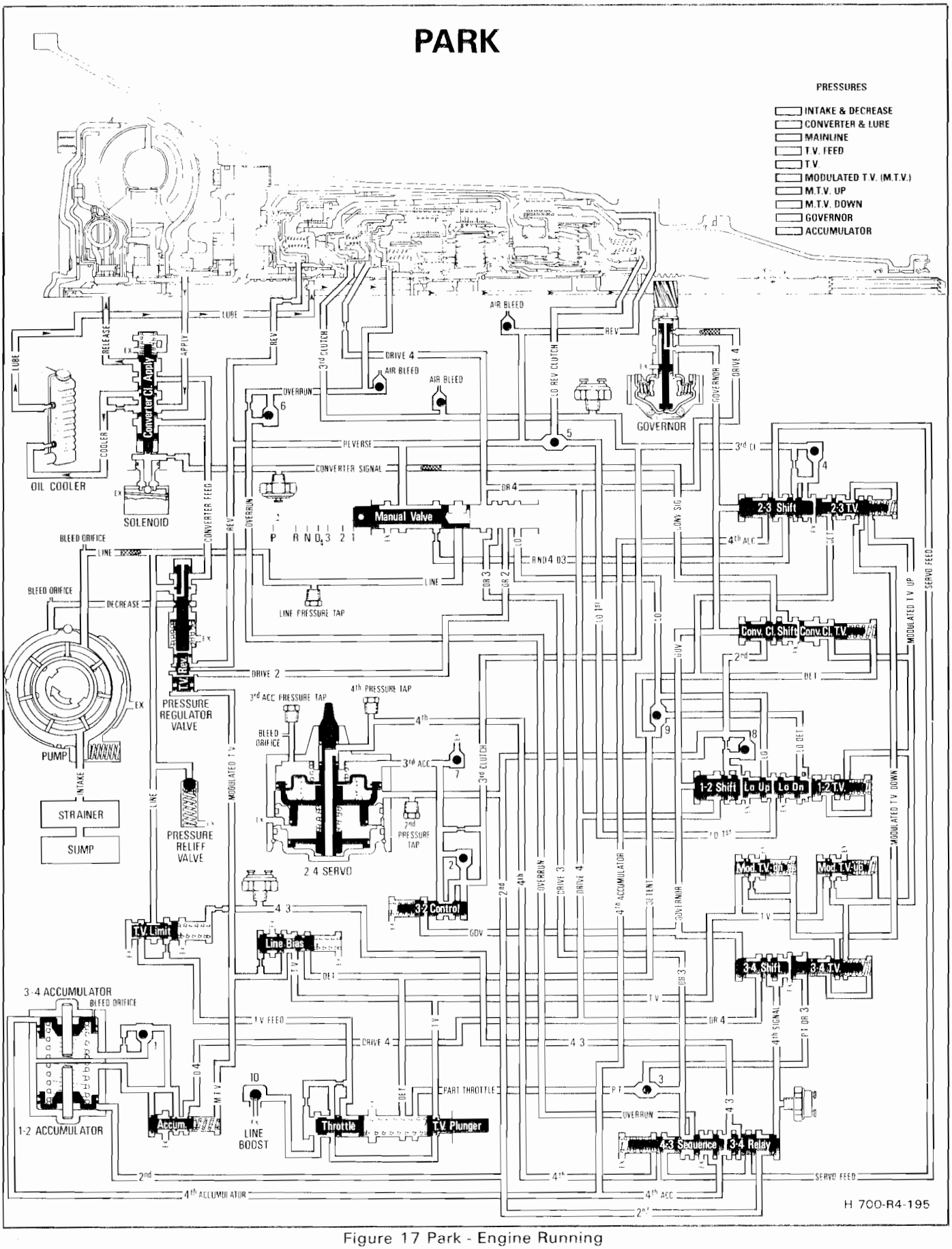


Figure 17 Park - Engine Running

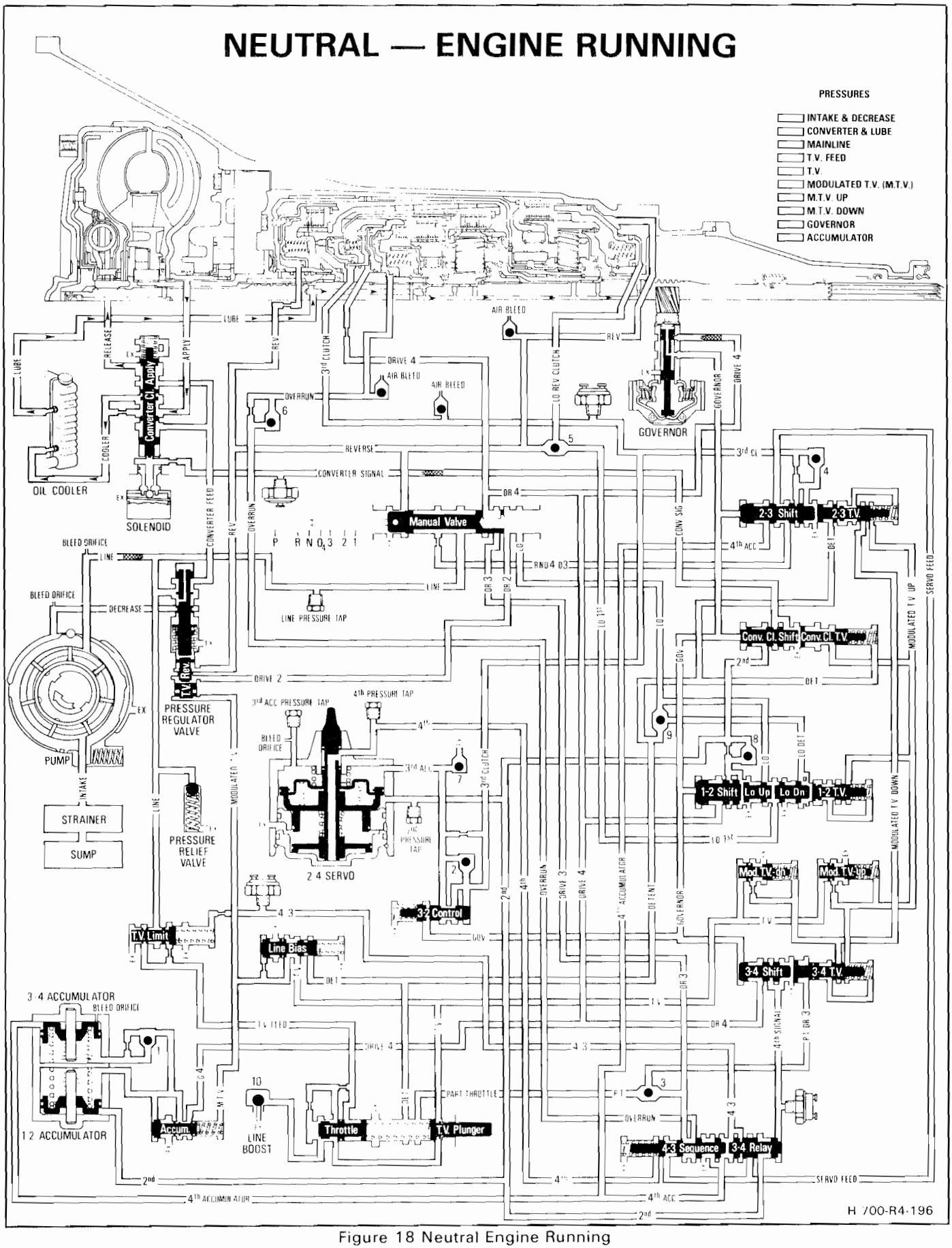


Figure 18 Neutral Engine Running

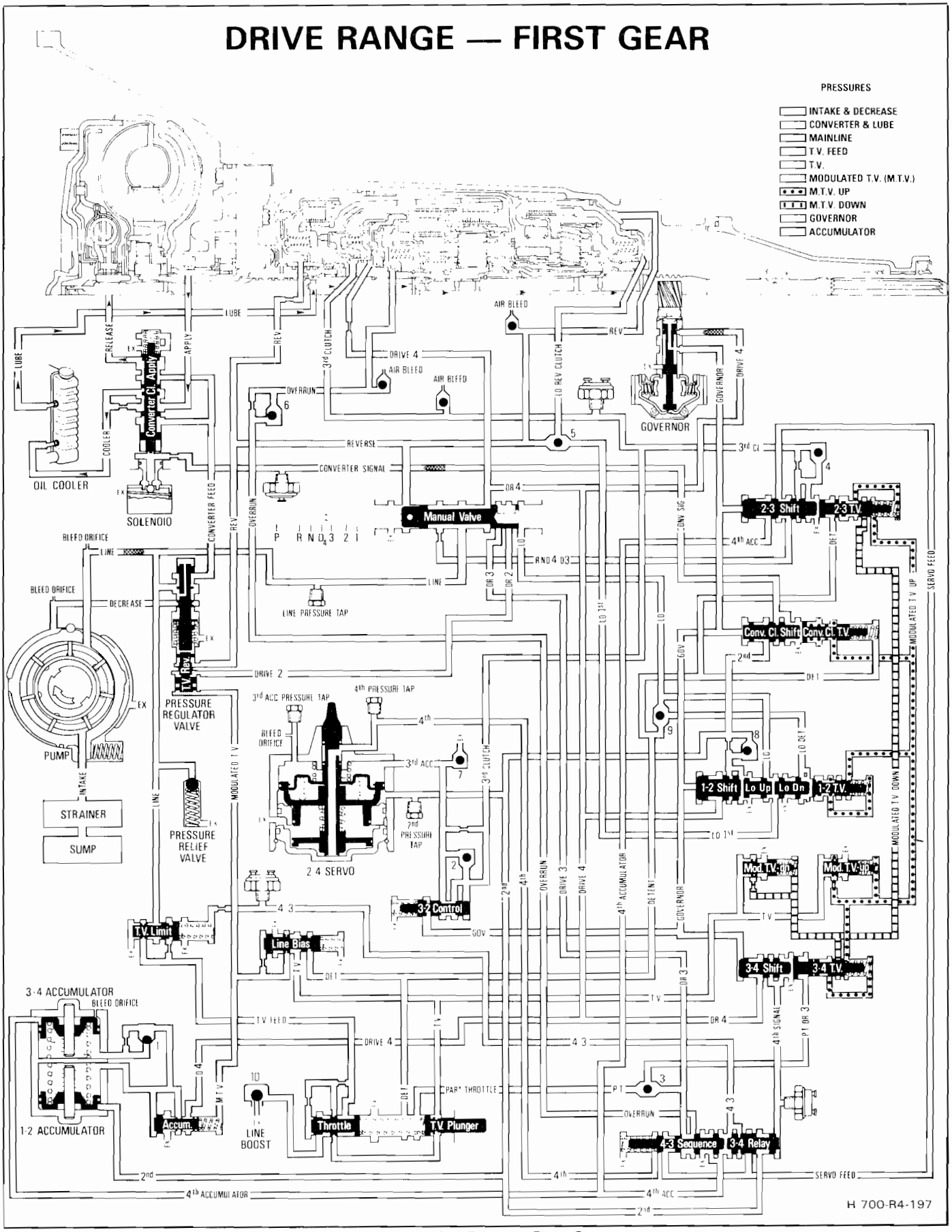


Figure 19 Drive Range - First Gear

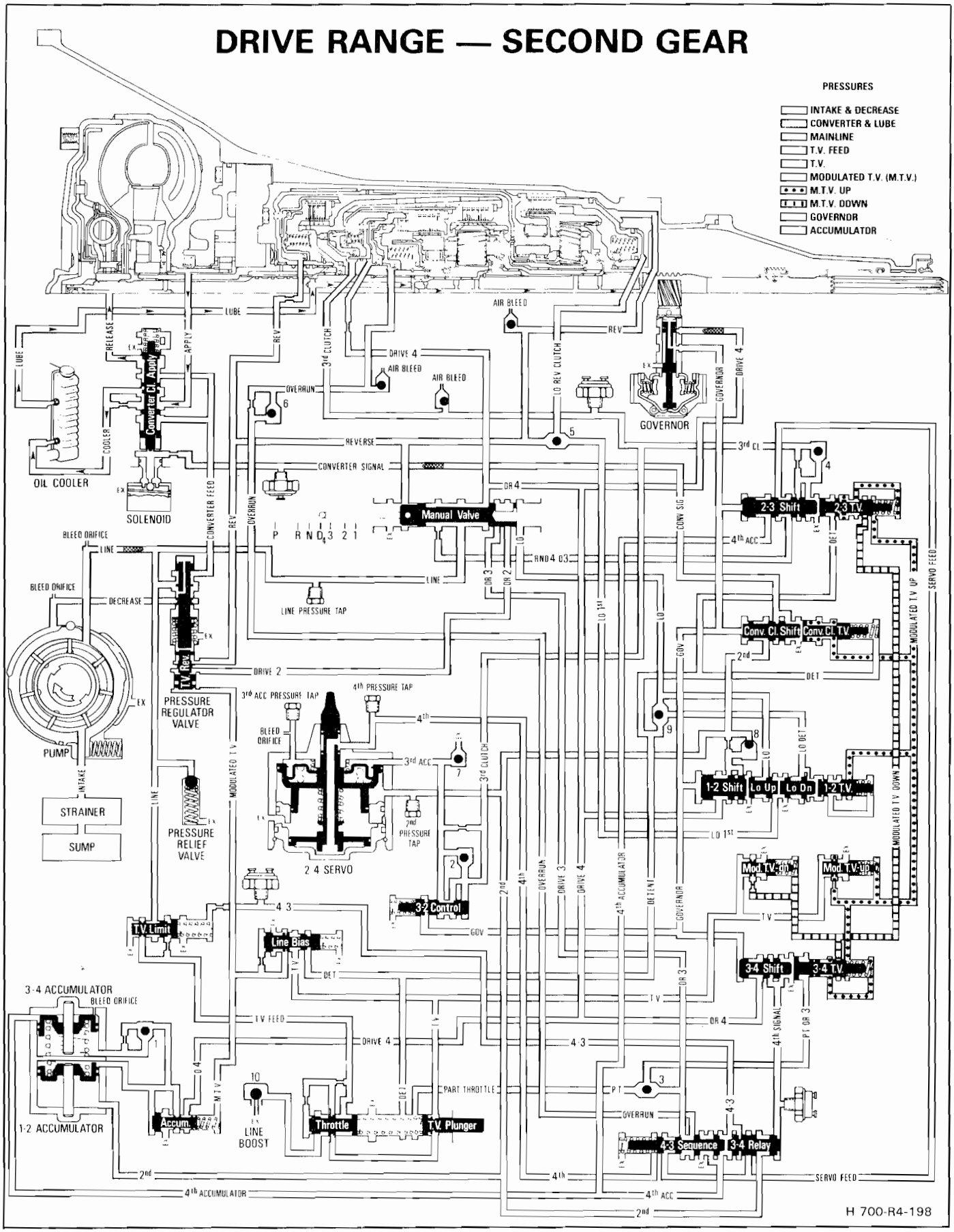


Figure 20 Drive Range - Second Gear

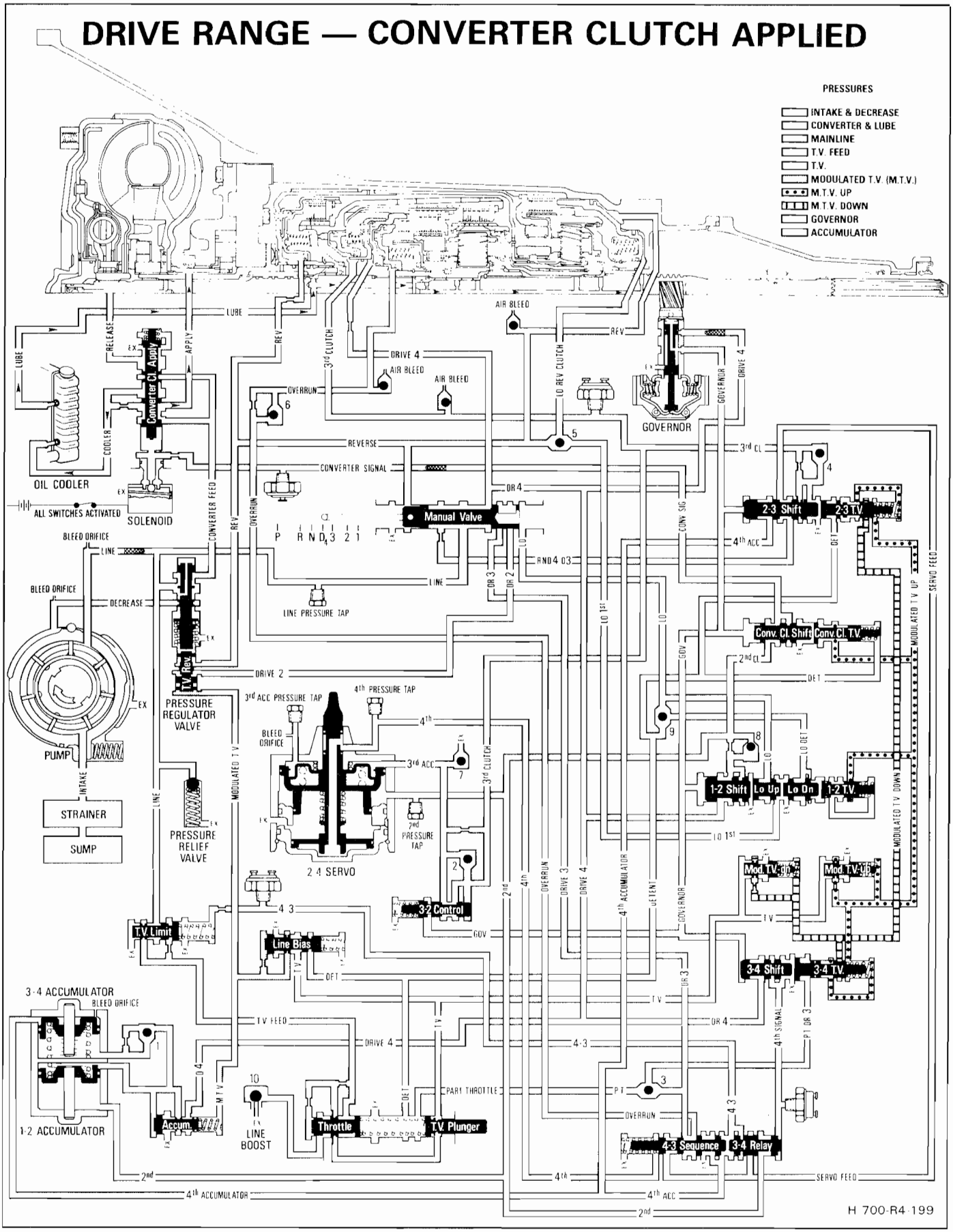


Figure 21 Drive Range, Converter Clutch Applied - Second Gear

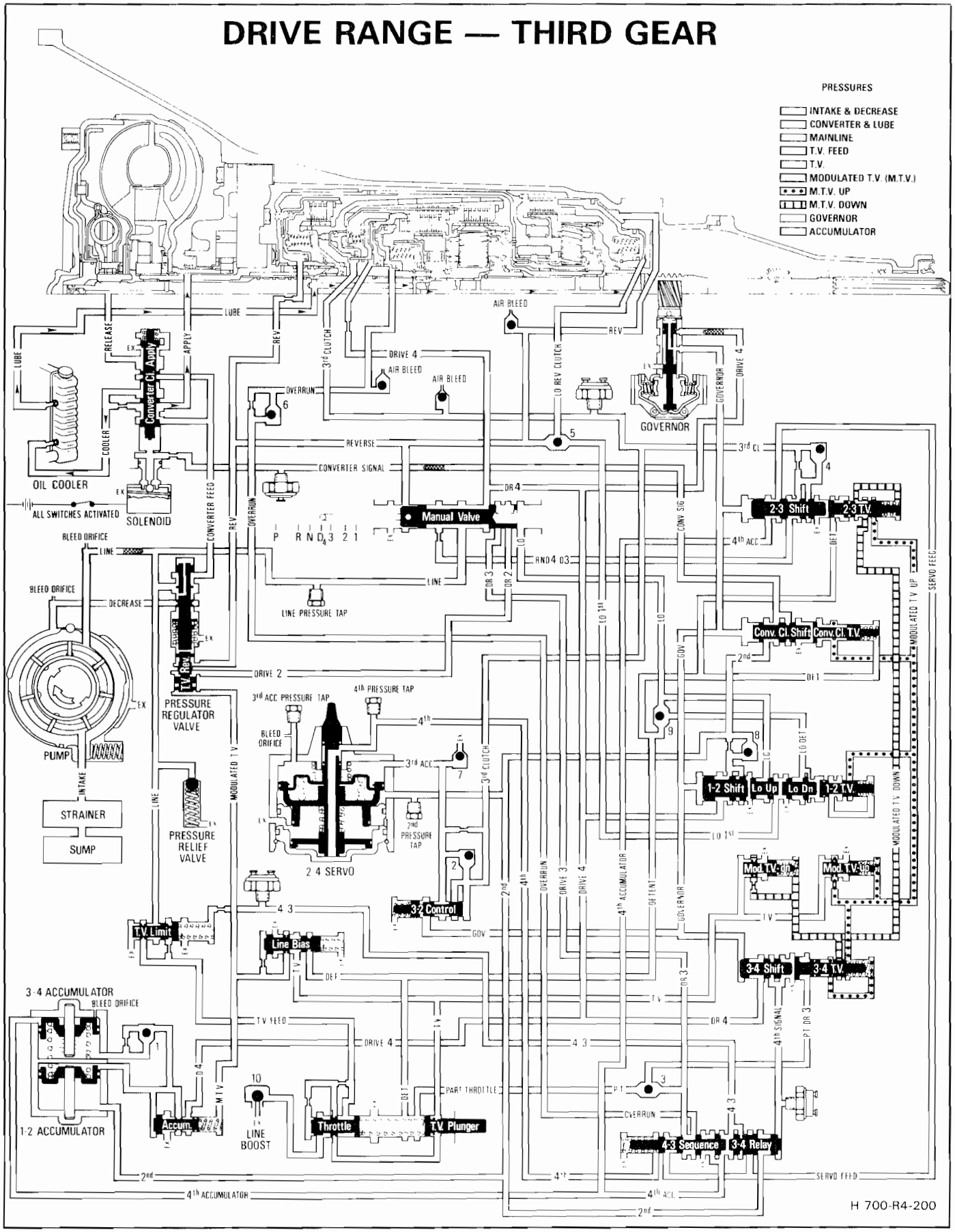


Figure 22 Drive Range - Third Gear

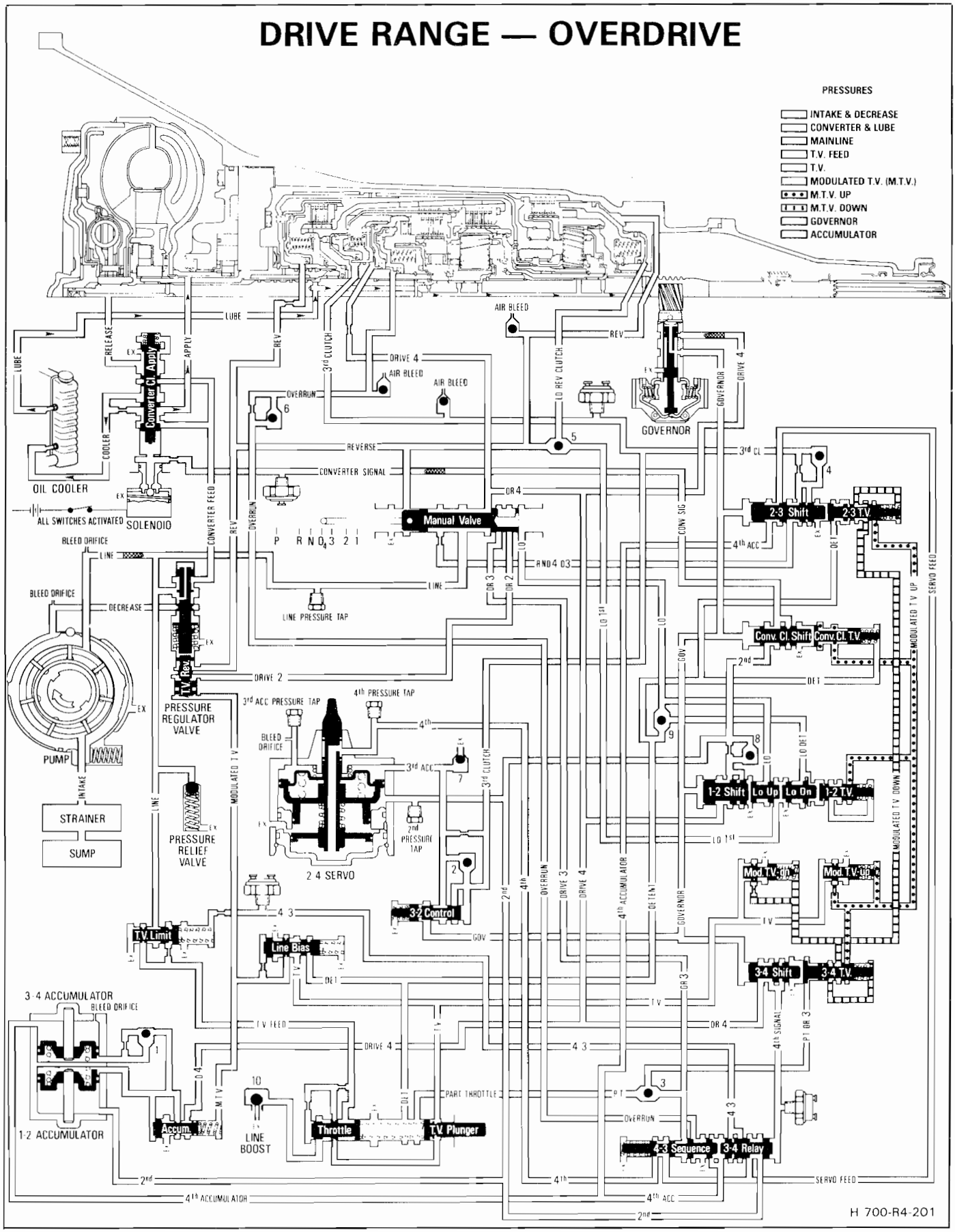


Figure 23 Drive Range - Overdrive

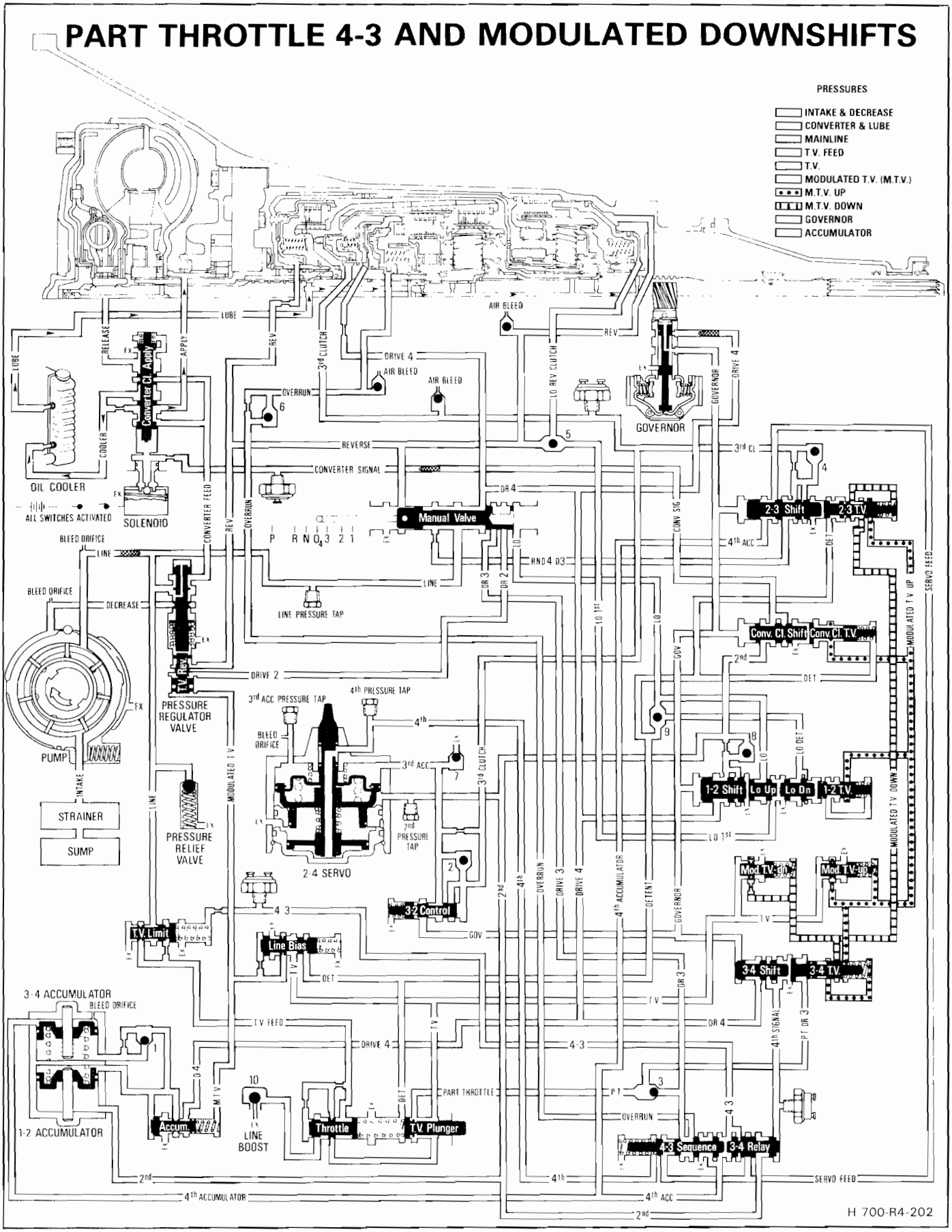


Figure 24 Part Throttle 4-3 and Modulated Downshifts, Values Shown in Third Gear Position

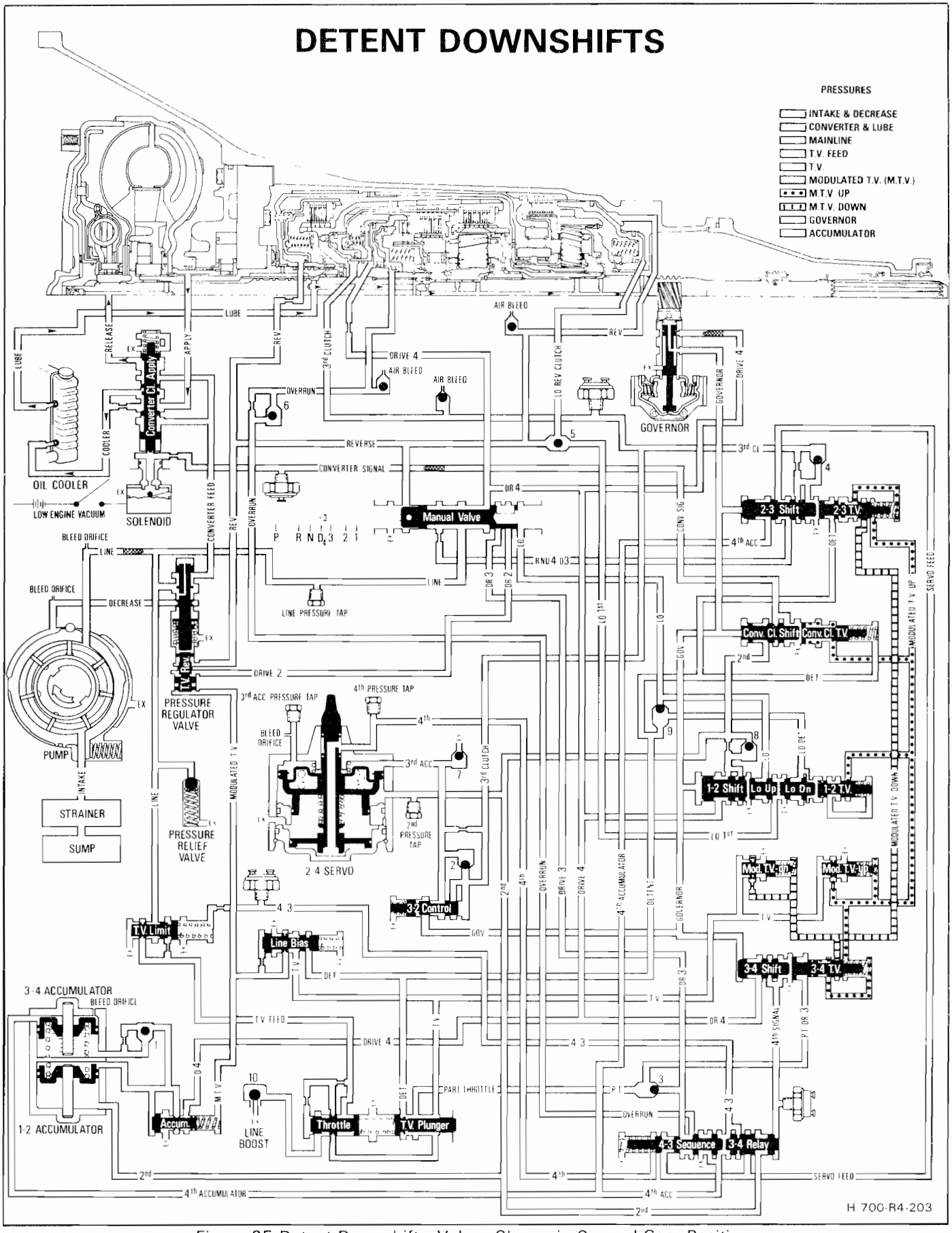


Figure 25 Detent Downshifts, Valves Shown in Second Gear Position

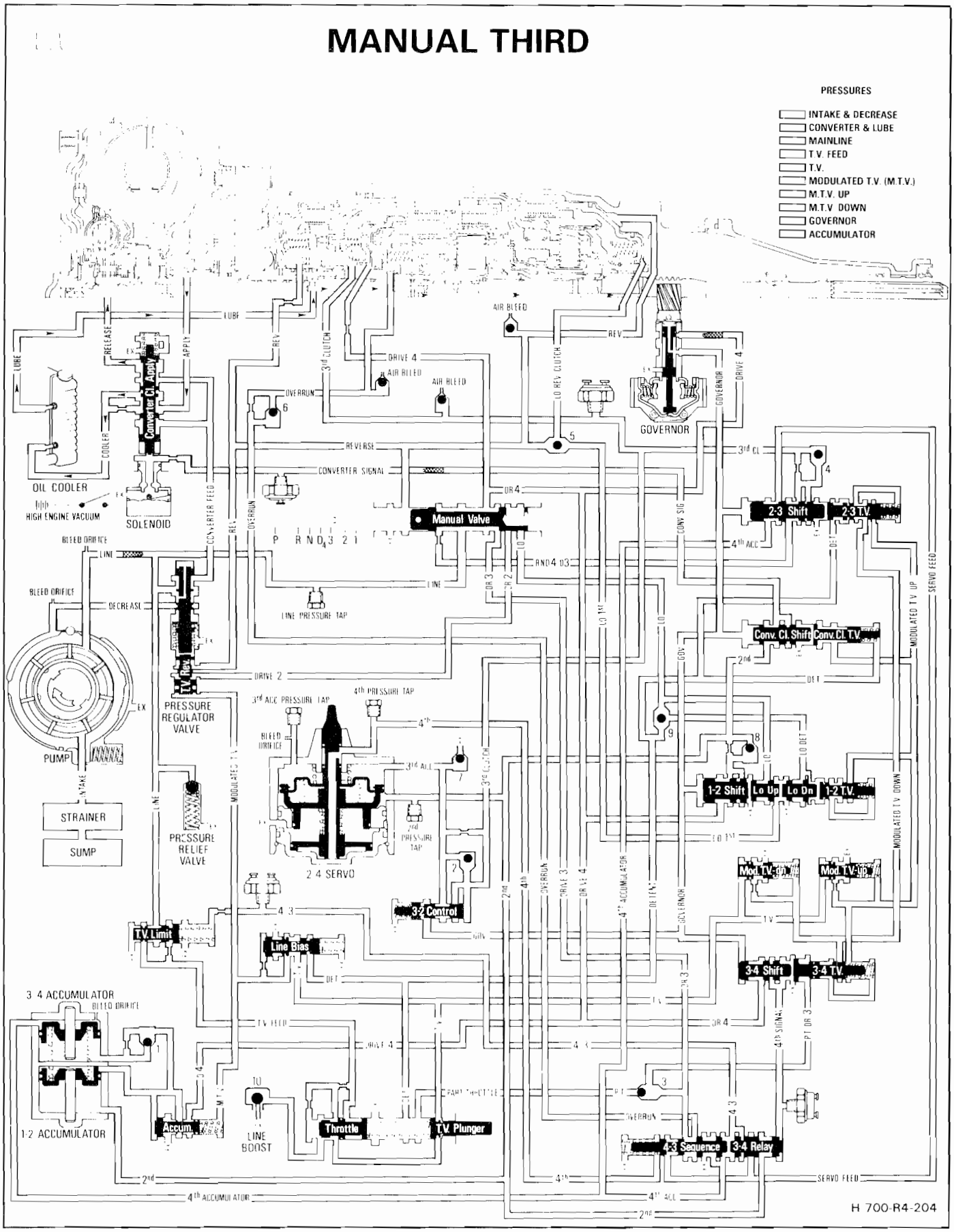


Figure 26 Manual Third

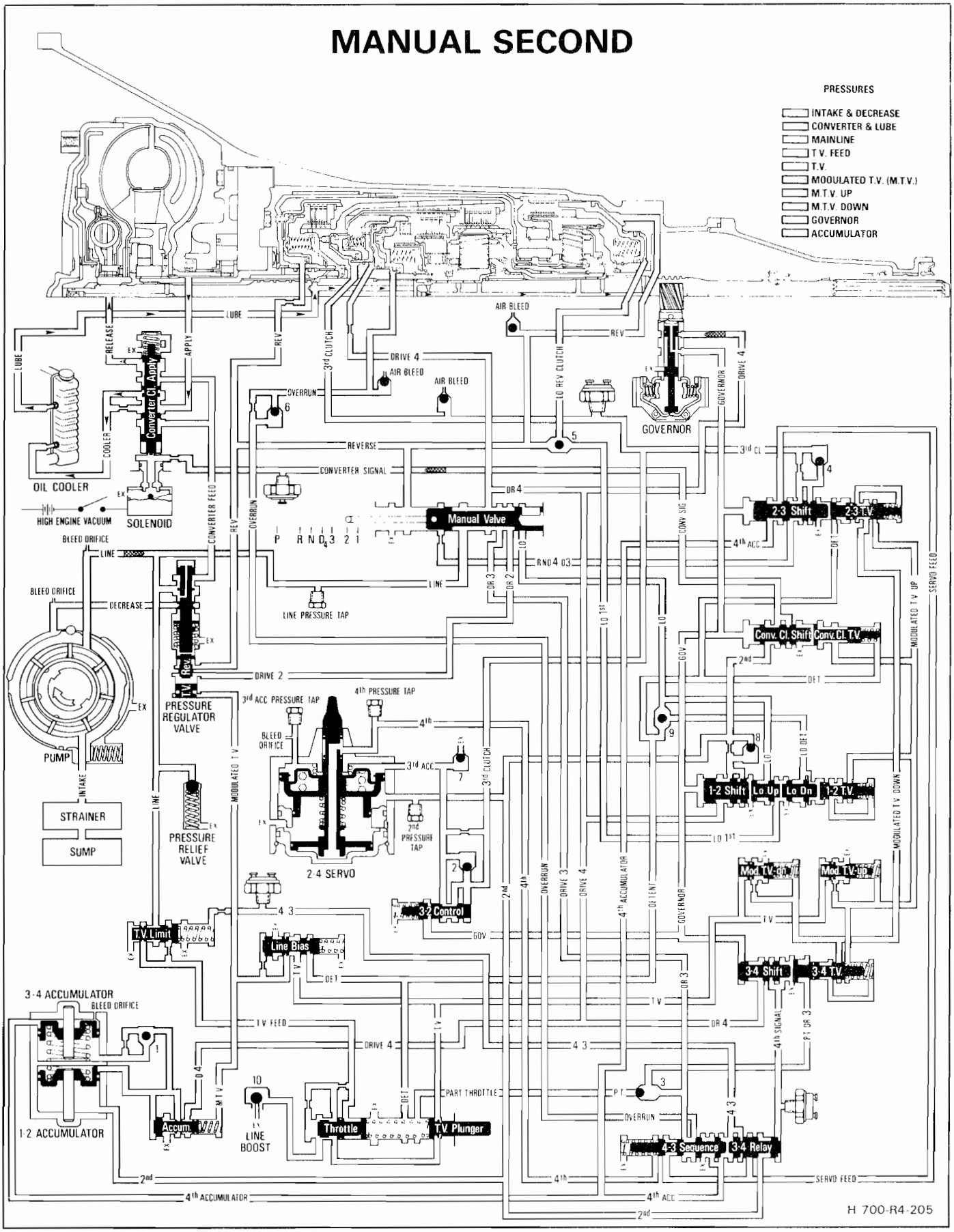


Figure 27 Manual Second

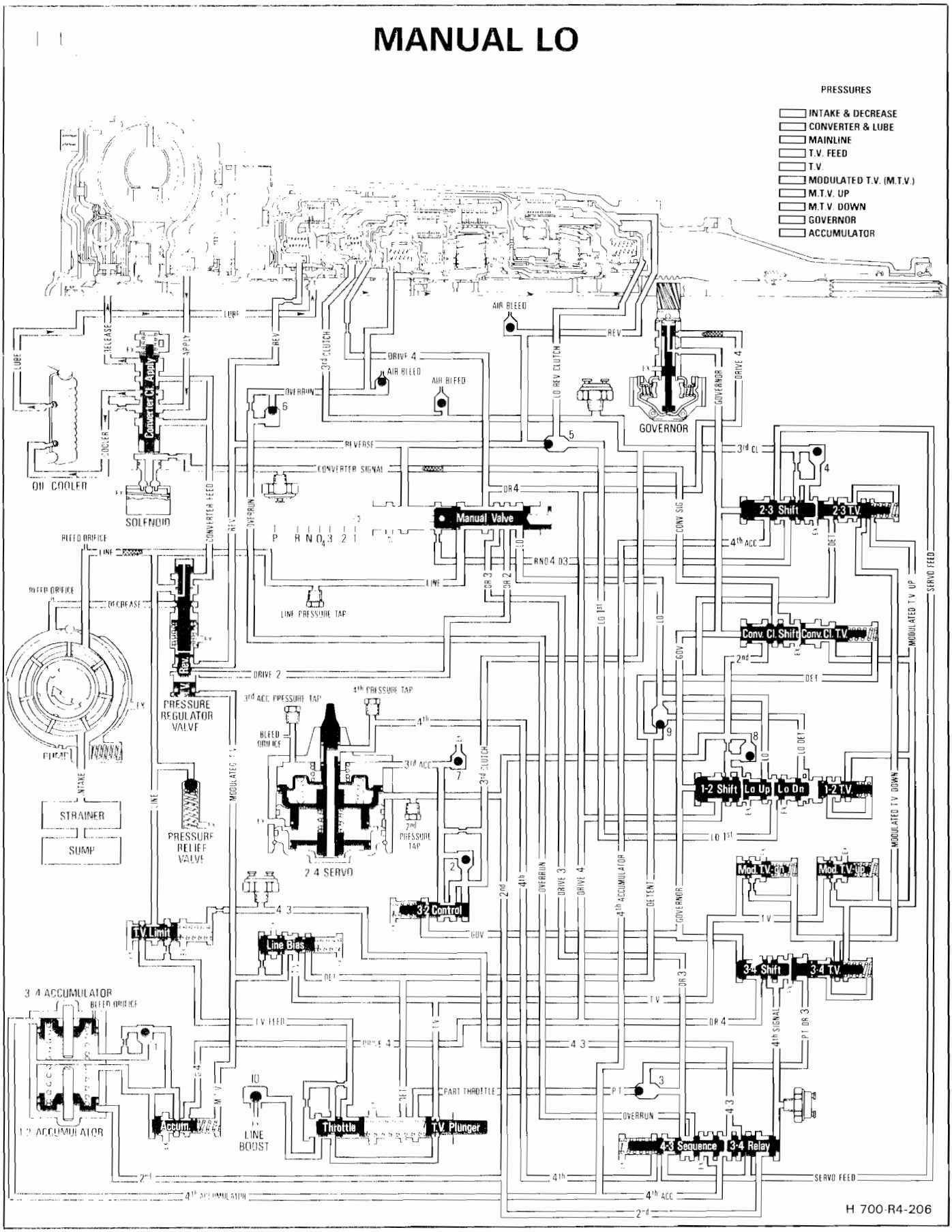


Figure 28 Manual Lo

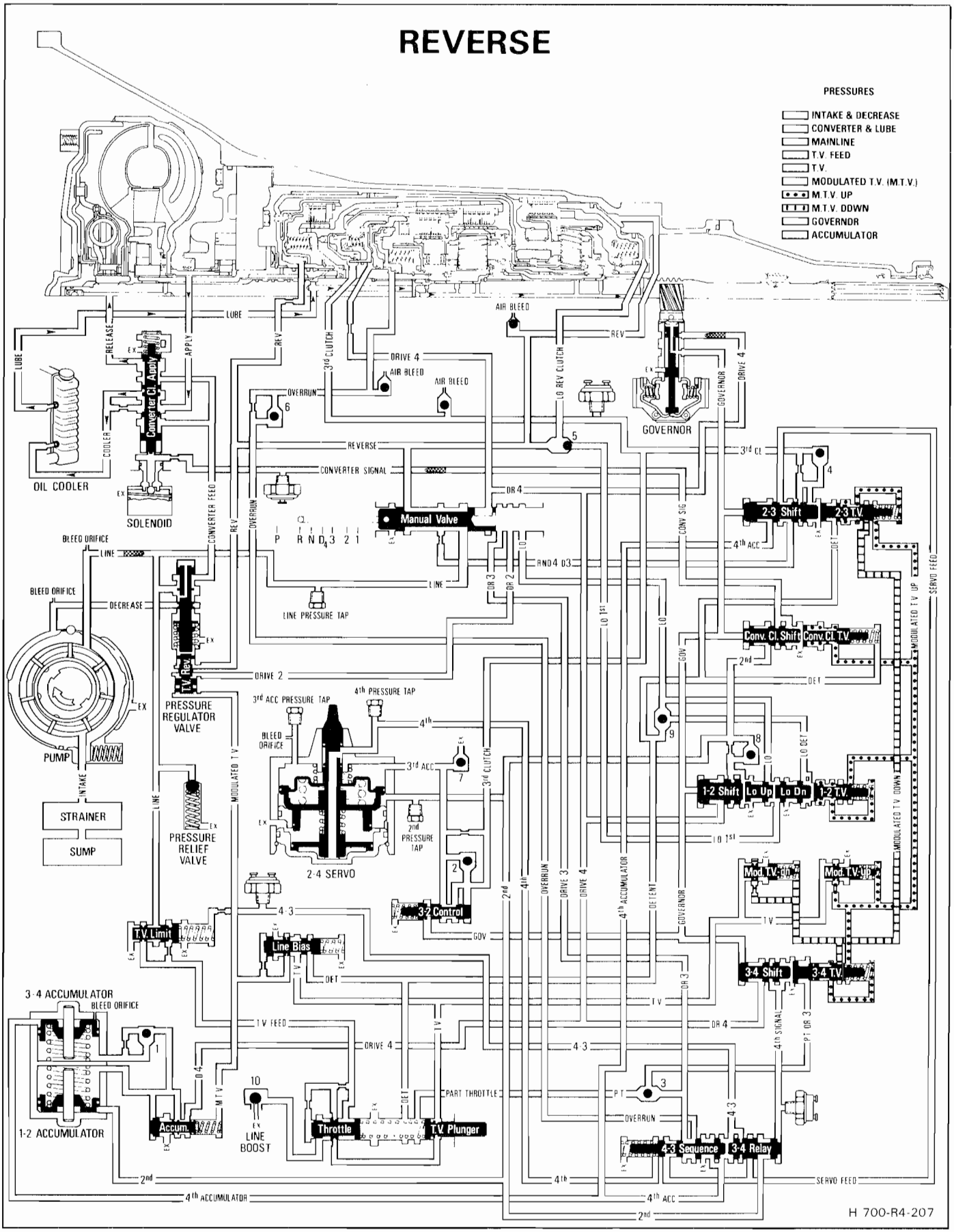
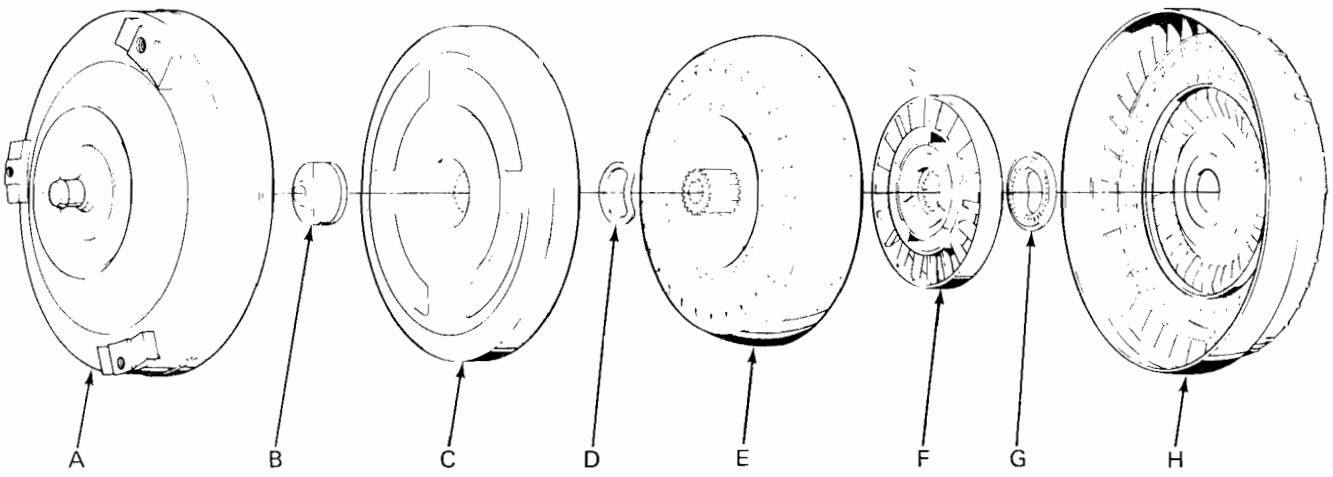


Figure 29 Reverse



A HOUSING COVER ASSEMBLY, CONVERTER
B SPACER, TURBINE THRUST
C PRESSURE PLATE ASSEMBLY
D SPRING, PRESSURE PLATE
E TURBINE ASSEMBLY
F STATOR ASSEMBLY
G THRUST BEARING ASSEMBLY
H CONVERTER PUMP ASSEMBLY

*THE TORQUE CONVERTER CLUTCH ASSEMBLY CANNOT BE DISASSEMBLED. SHOWN HERE FOR INFORMATION ONLY. SEE SECTION 7A FOR MORE INFORMATION.

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Figure 30 Typical Converter

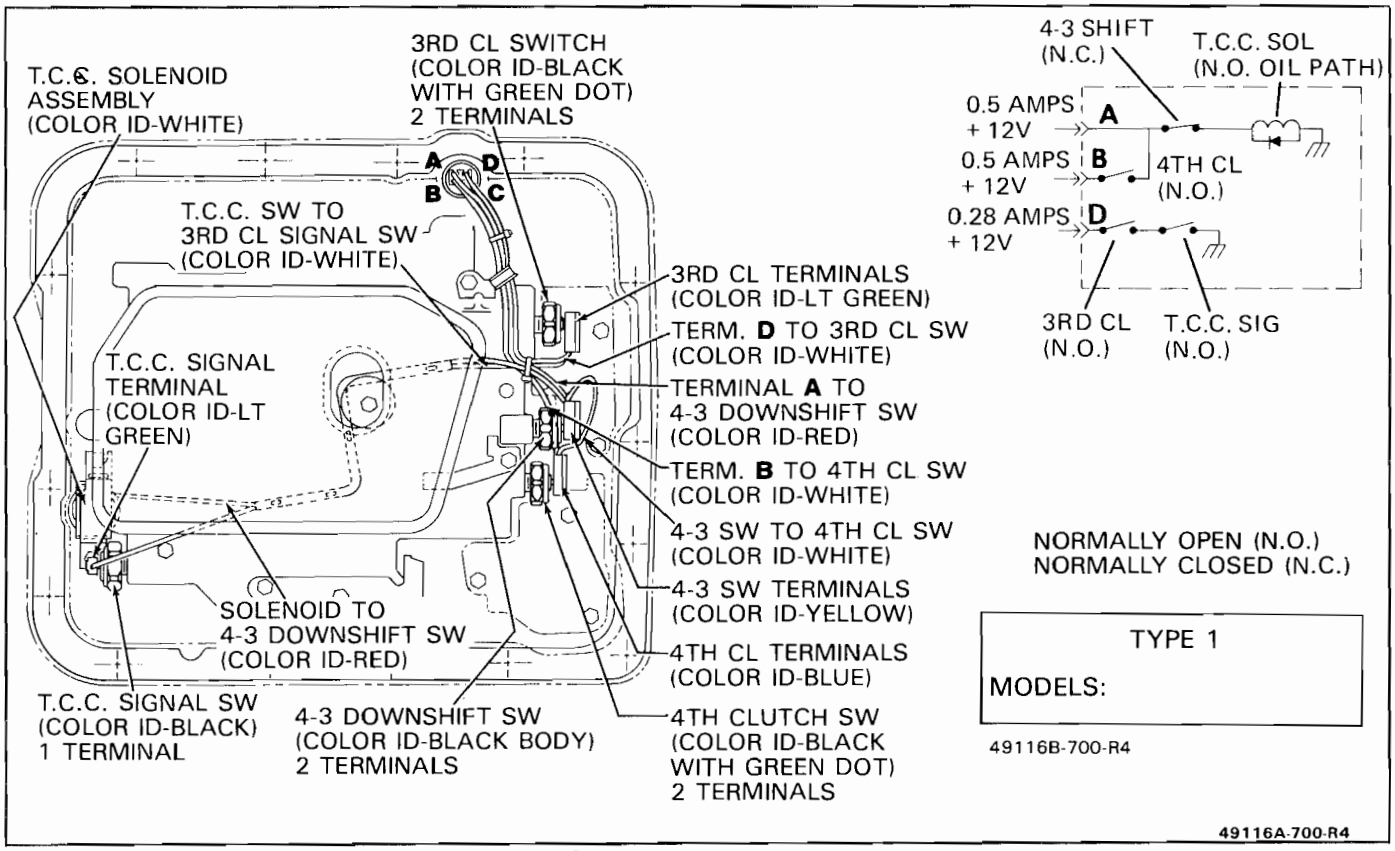


Figure 31 Wiring Diagram - Type 1

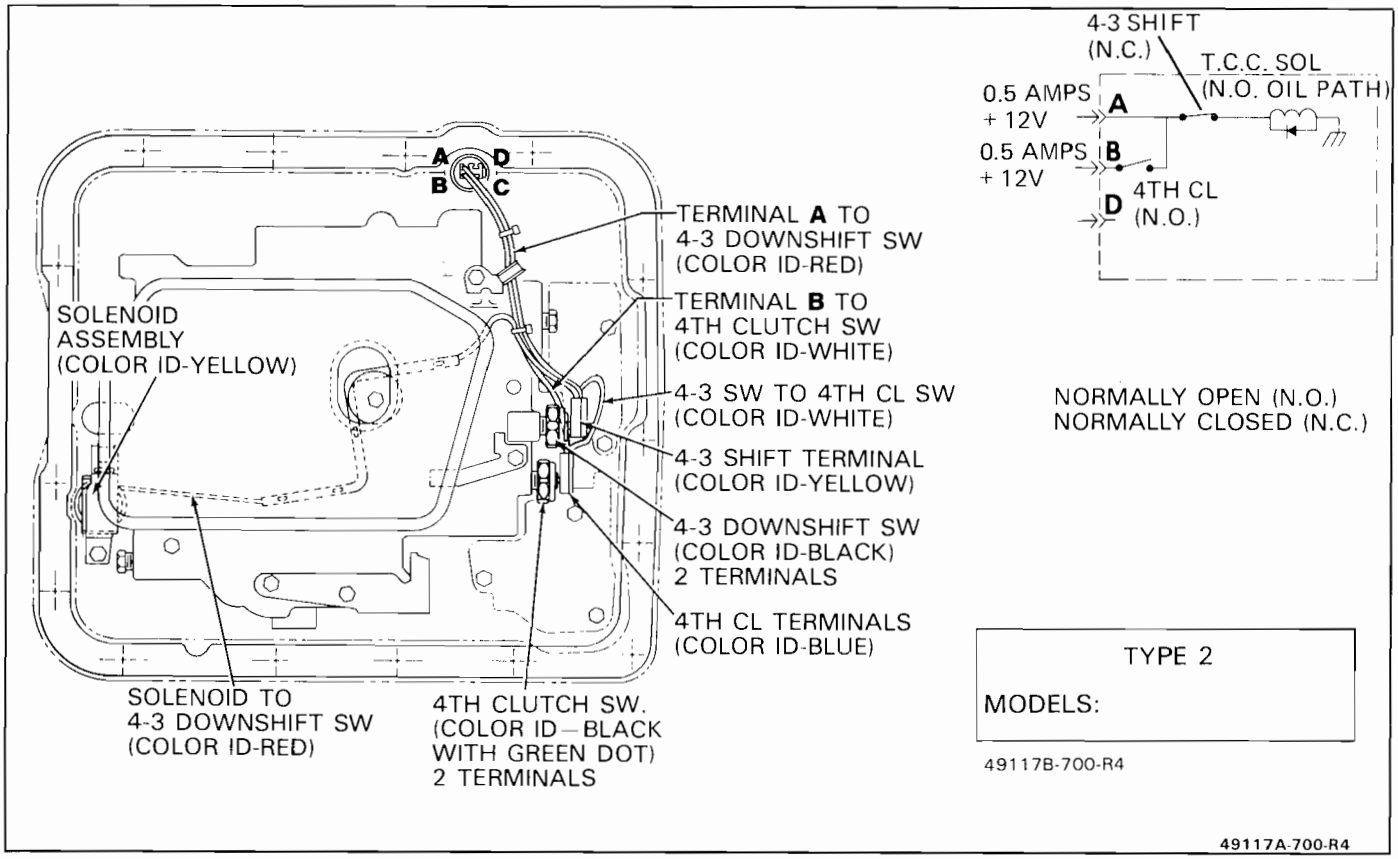


Figure 32 Wiring Diagram - Type 2

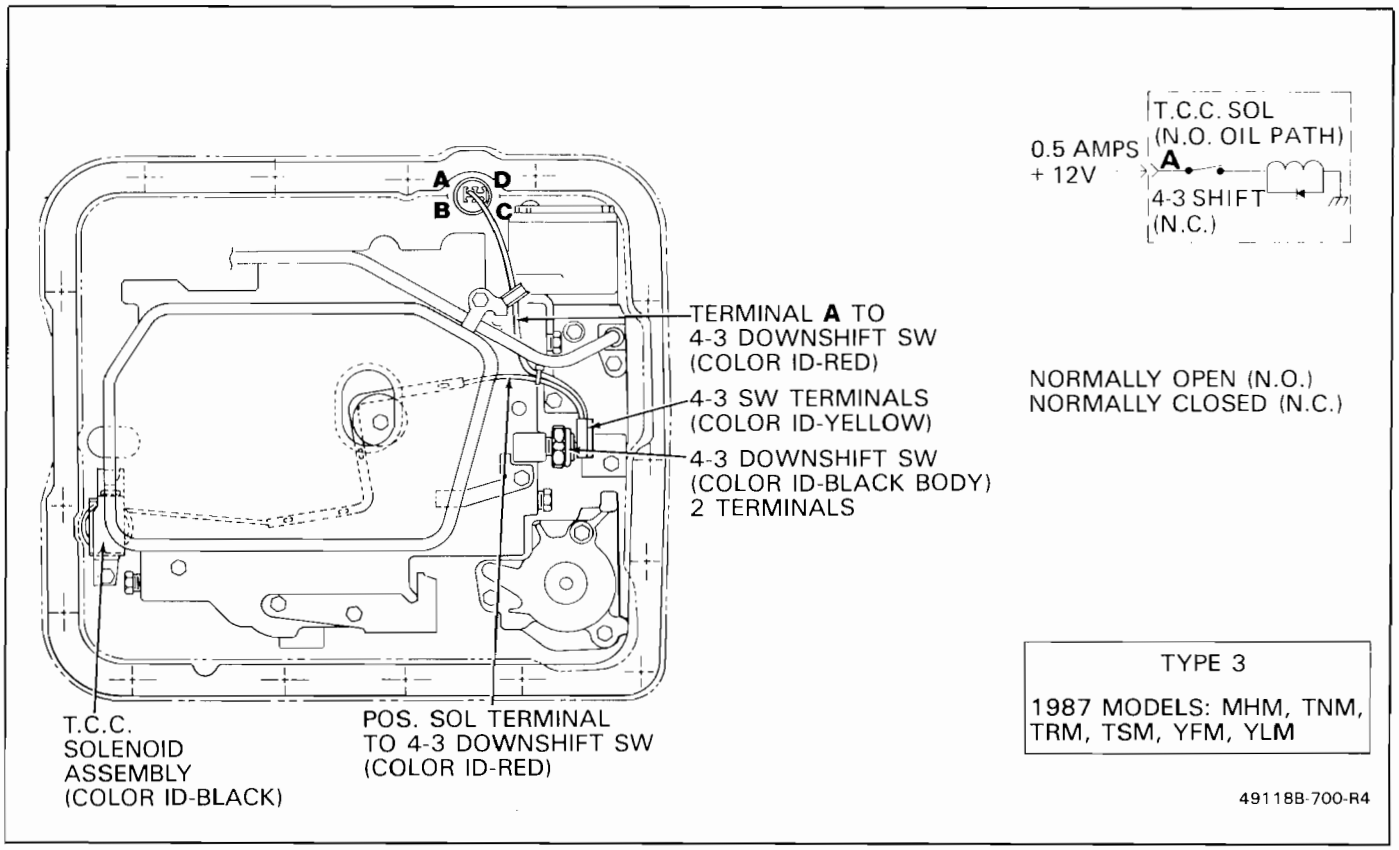


Figure 33 Wiring Diagram - Type 3

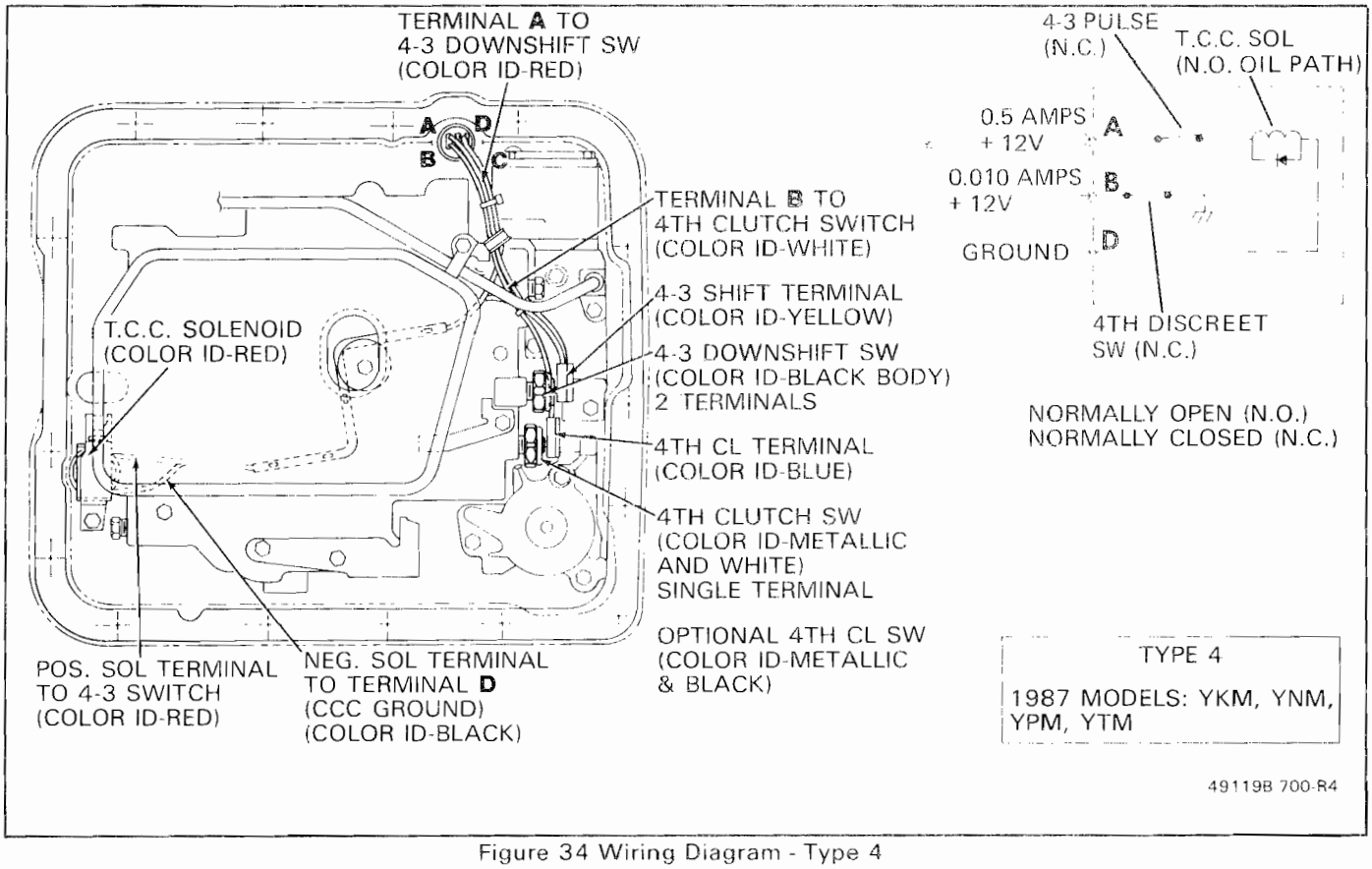


Figure 34 Wiring Diagram - Type 4

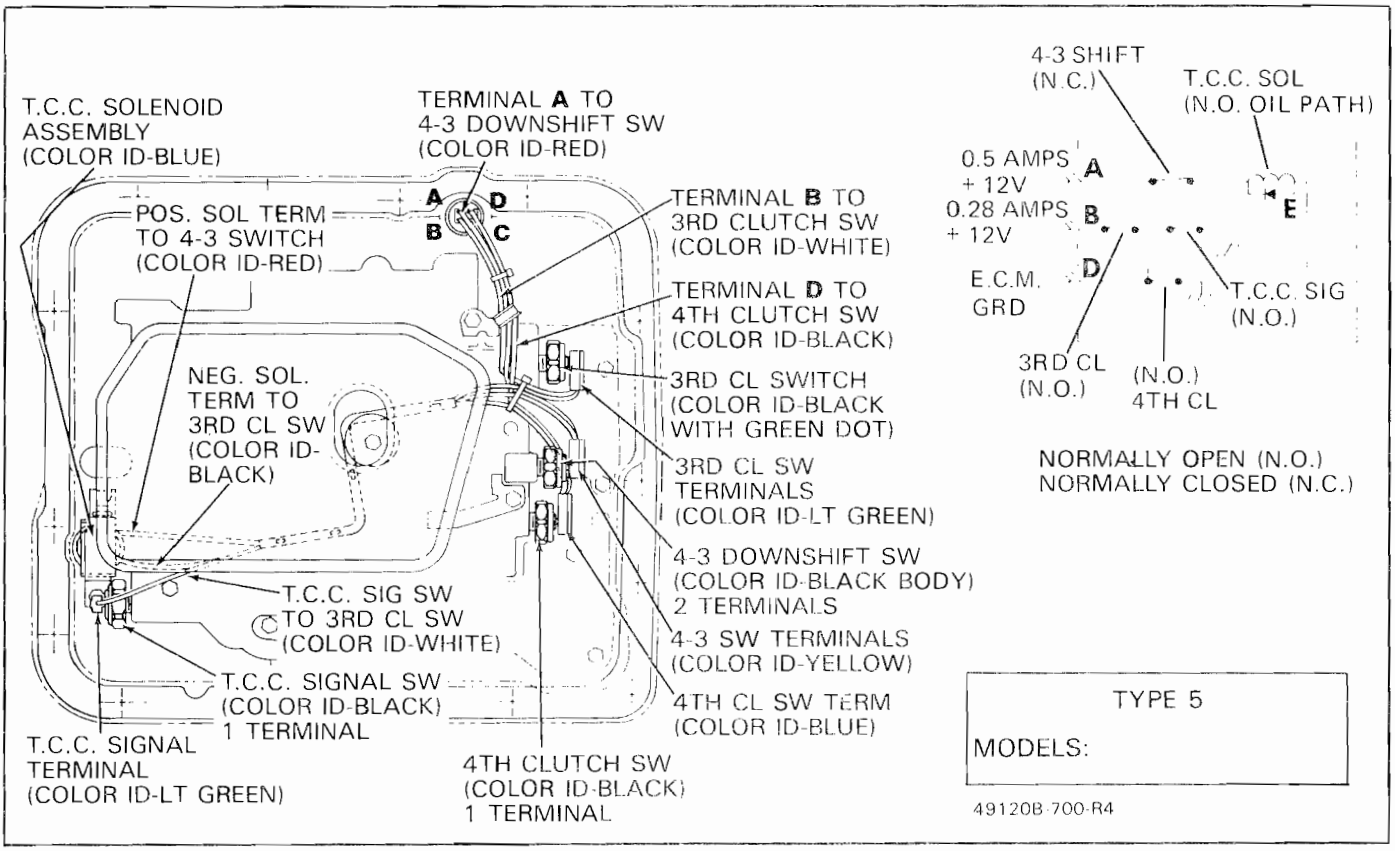


Figure 35 Wiring Diagram - Type 5

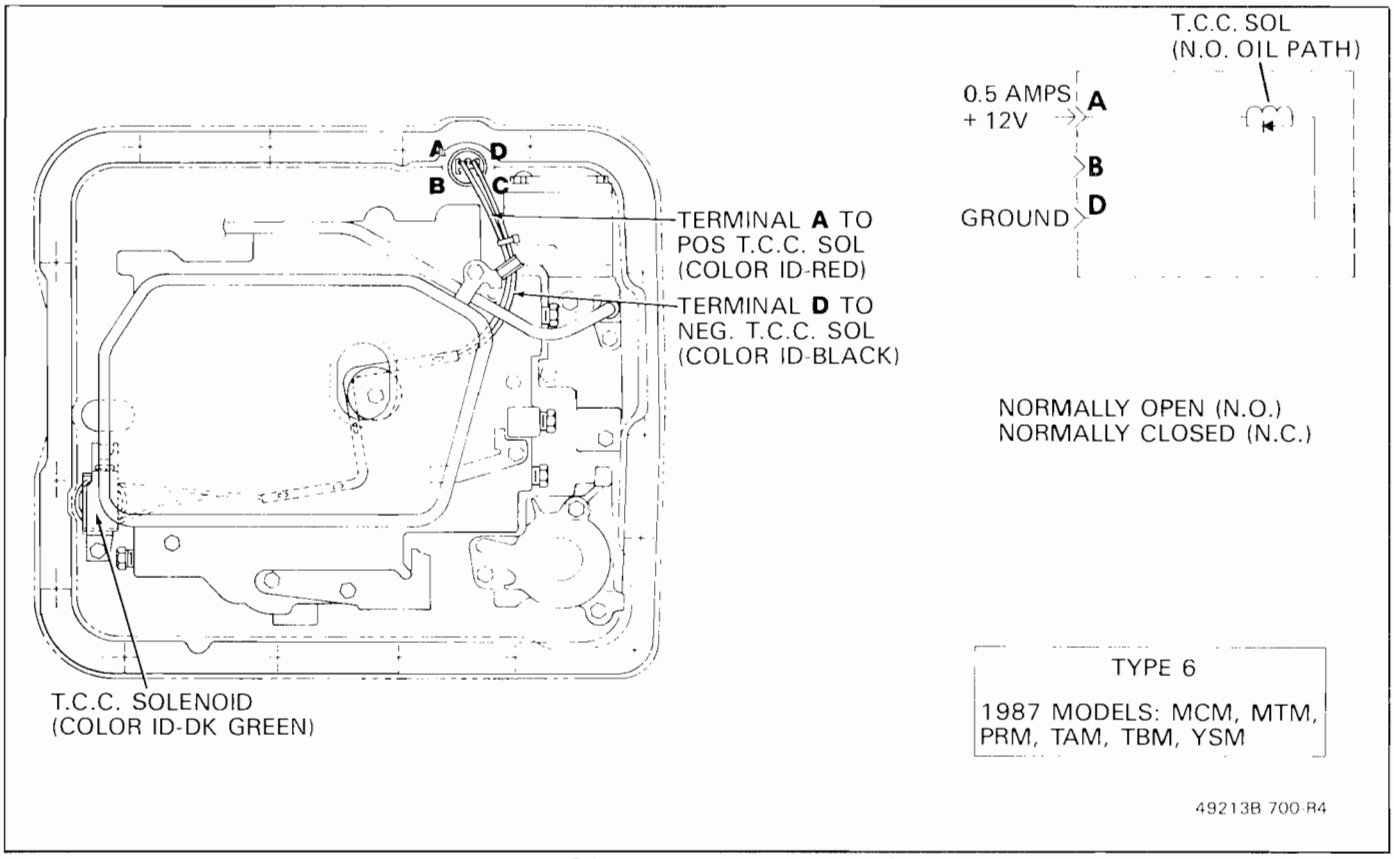


Figure 36 Wiring Diagram - Type 6

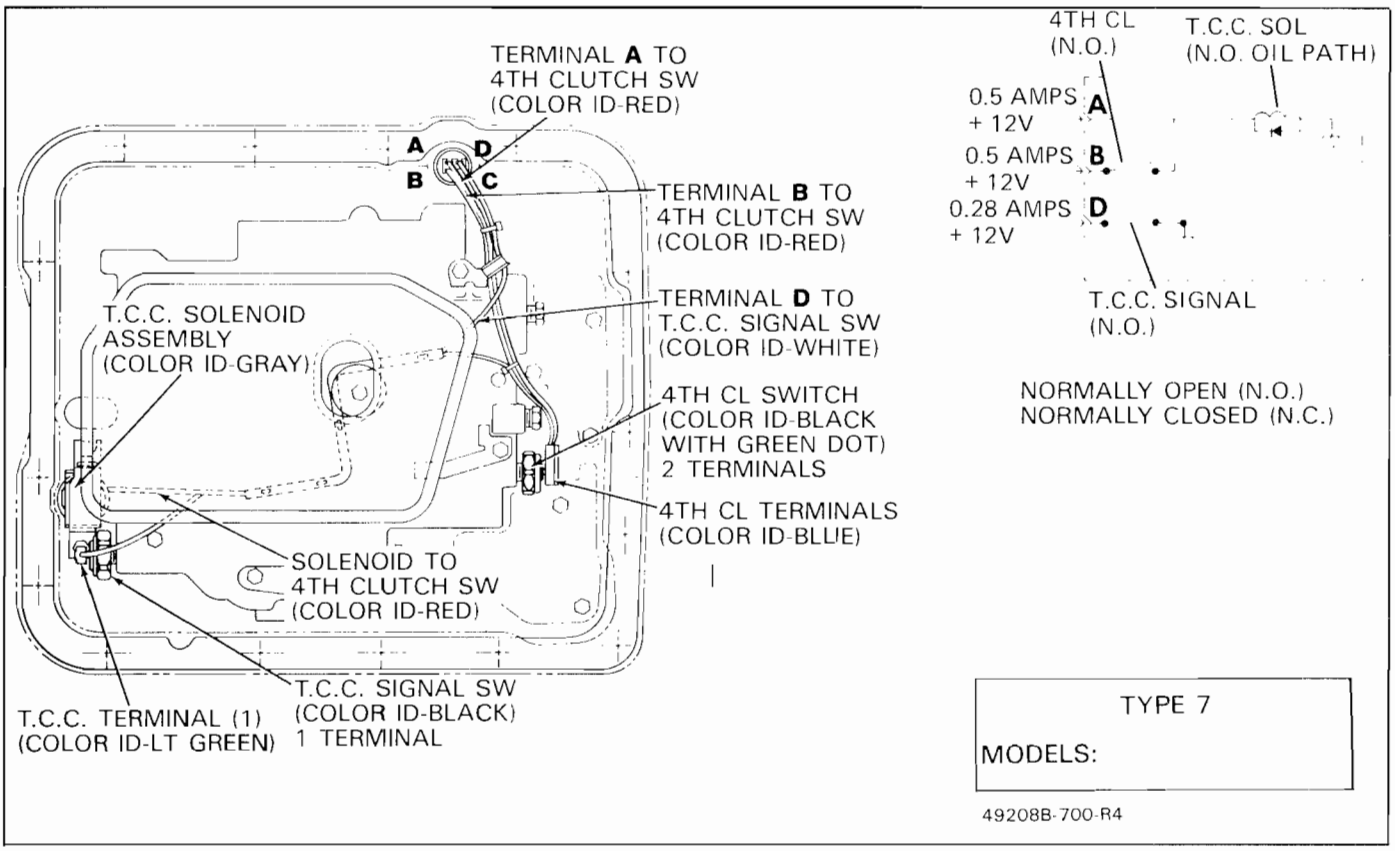


Figure 37 Wiring Diagram - Type 7

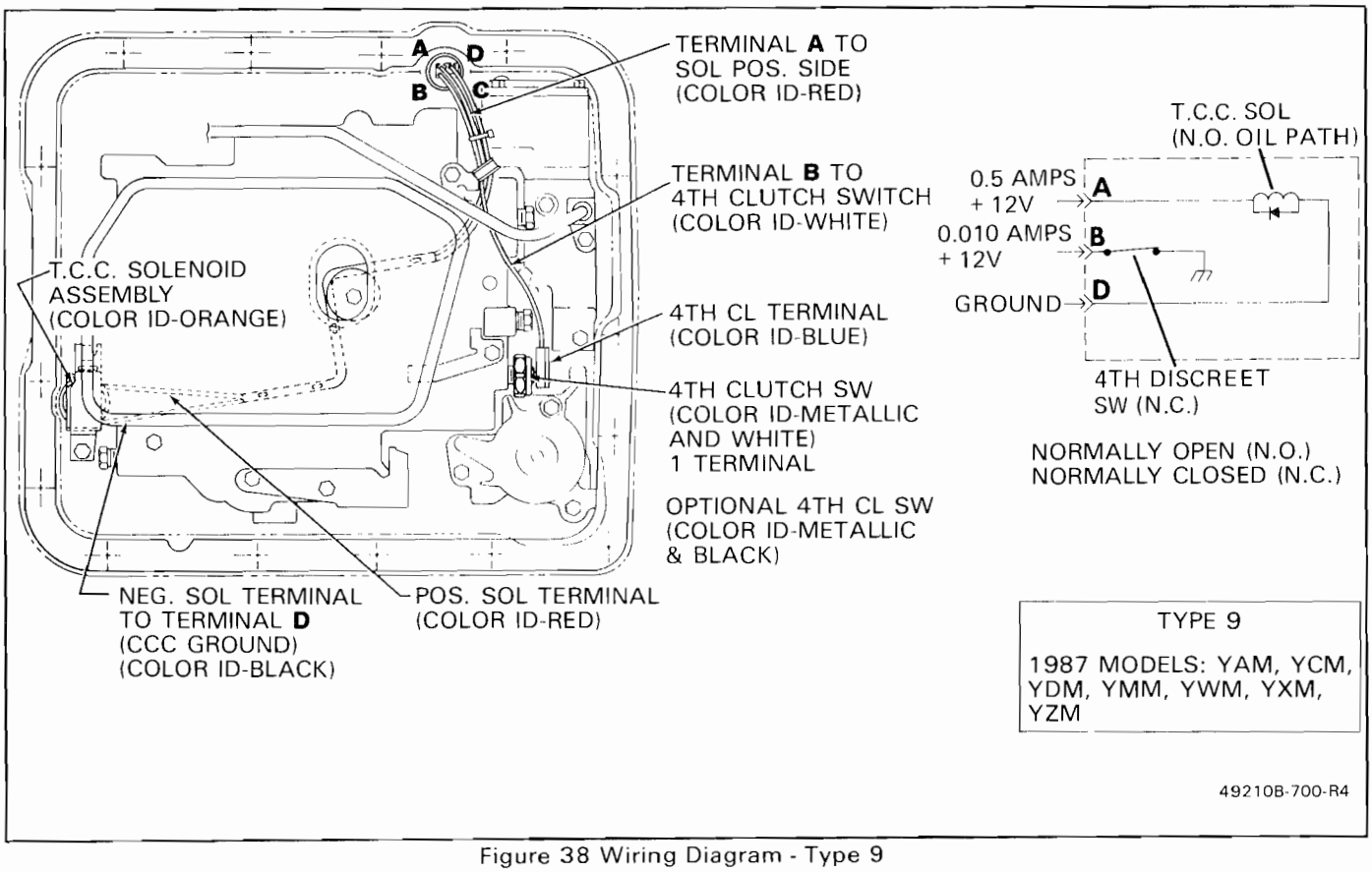


Figure 38 Wiring Diagram - Type 9

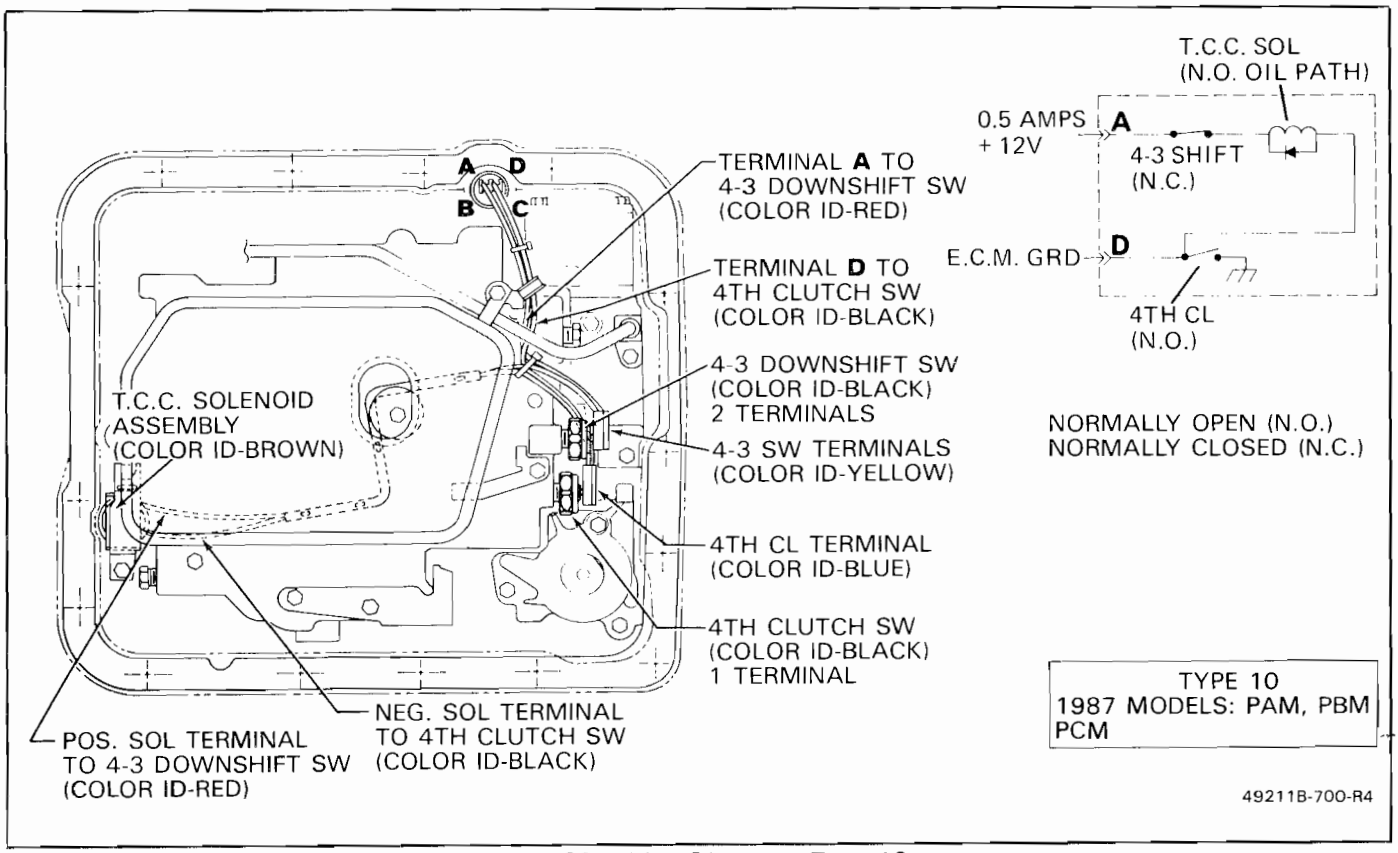


Figure 39 Wiring Diagram - Type 10

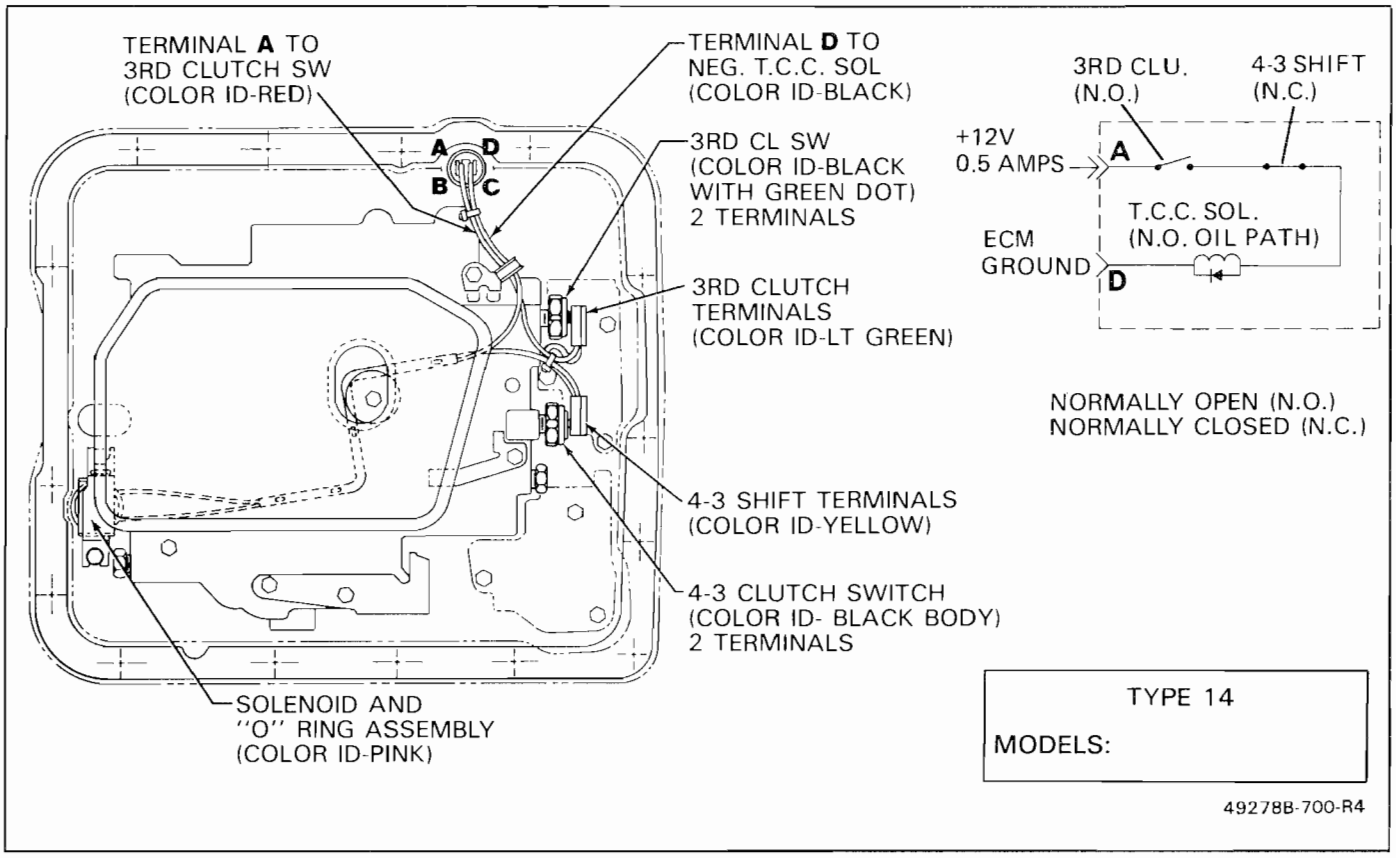


Figure 40 Wiring Diagram - Type 14

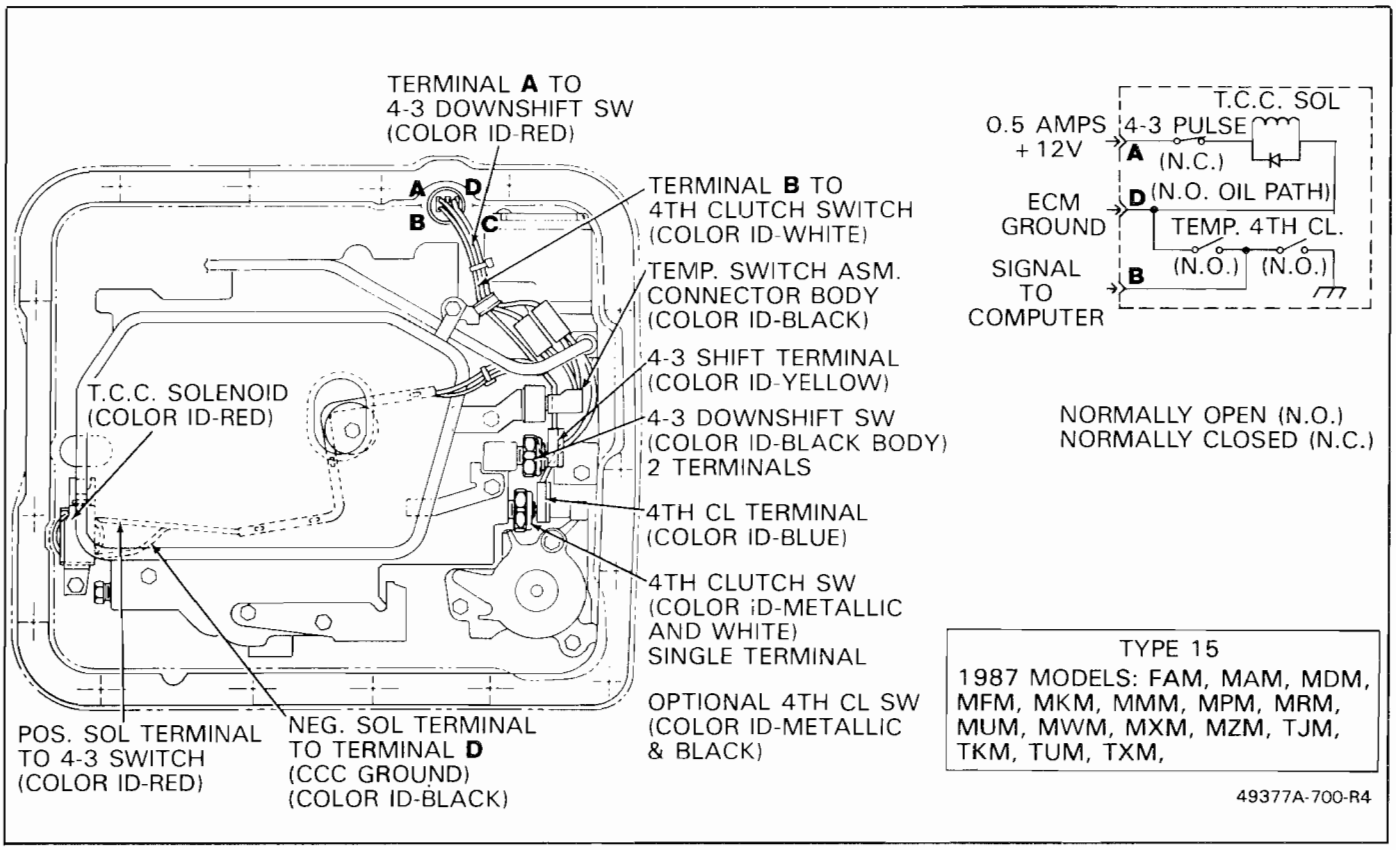
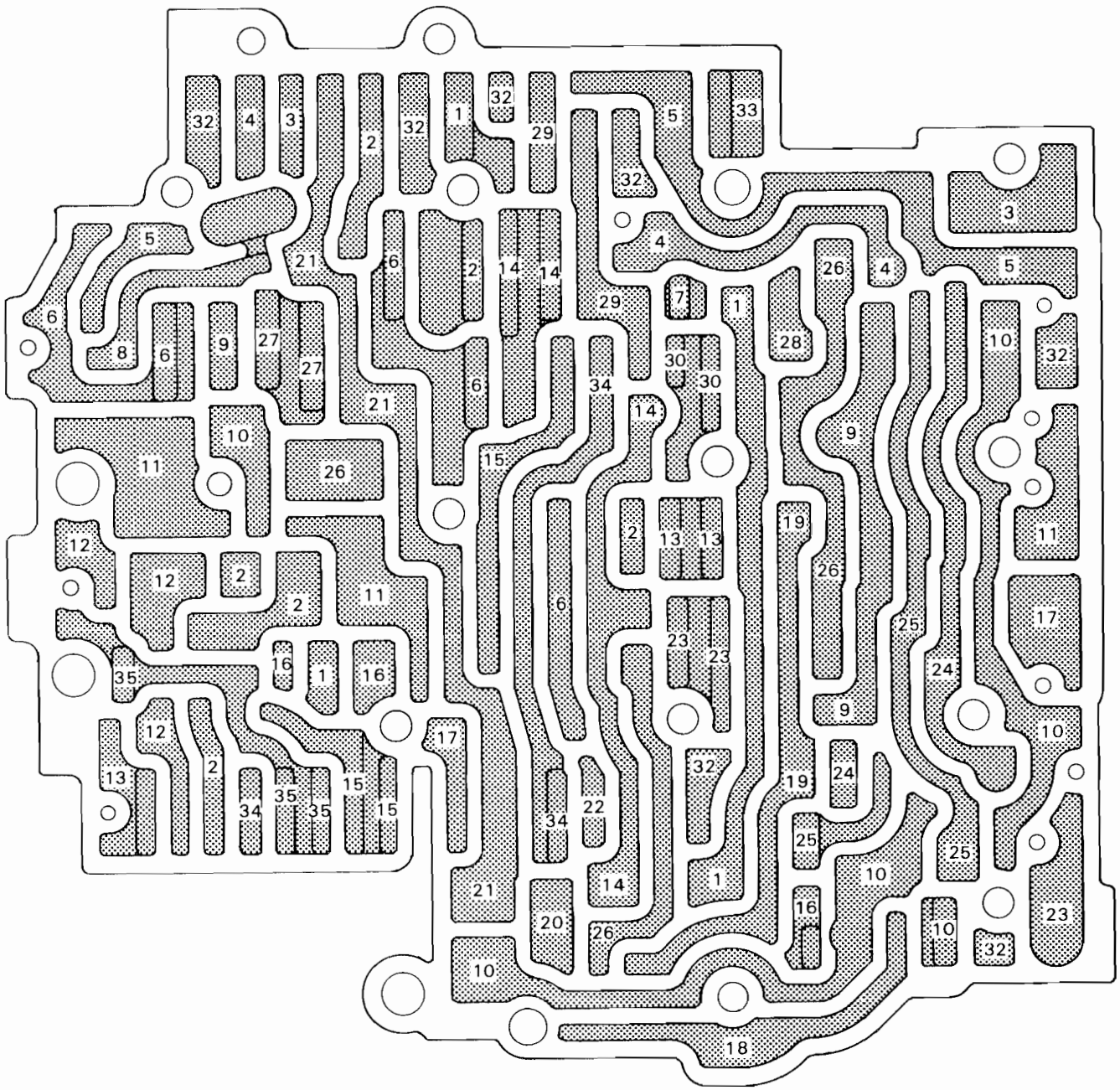


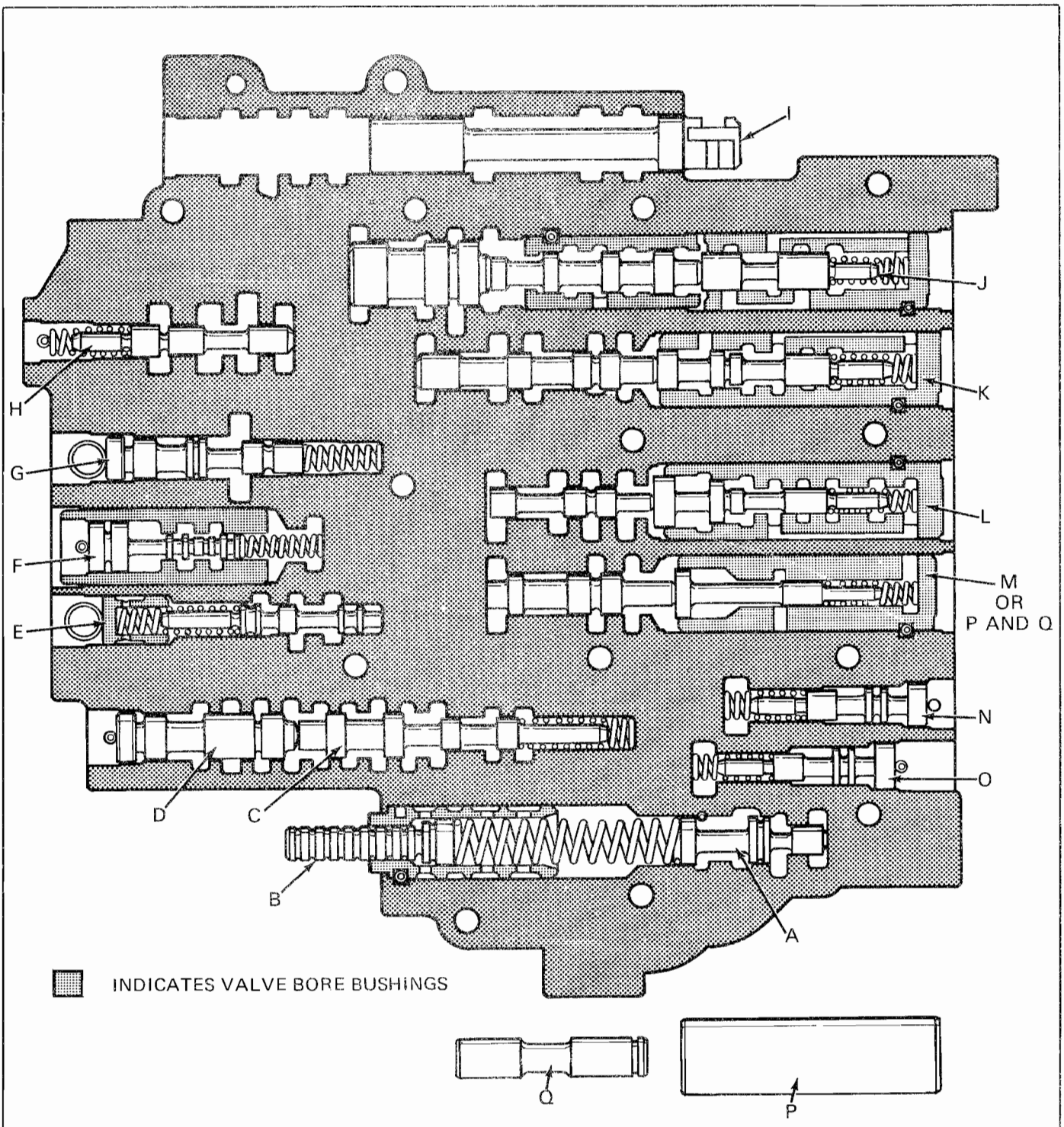
Figure 41 Wiring Diagram - Type 15



1 LINE
2 D4
3 D2
4 LO
5 REVERSE
6 GOVERNOR
7 LO - 1ST FEED
8 LO/REVERSE
9 3RD ACCUMULATOR
10 T.V.
11 M.T.V.
12 ACCUMULATOR
13 4TH SIGNAL
14 2ND CLUTCH
15 3-4 ACCUMULATOR
16 T.V.F.
17 OVERRUN CLUTCH
18 T.V. EX.
19 D3/PART THROTTLE
20 PART THROTTLE
21 D3
22 4TH CLUTCH
23 C.C. SIG.
24 MOD. UP
25 MOD. DOWN
26 DETENT
27 3-4 CLUTCH
28 DETENT/LO
29 RND4-3
30 3RD CLUTCH
31 IDENTIFICATION
32 VOID
33 EXHAUST
34 SF
35 4-3
42 D4 ABUSE
43 3RD FEED
44 3-2 HIGH SPEED
45 2ND FEED
46 3RD CL. EXHAUST
47 4TH FEED
48 1-2 ACCUMULATOR

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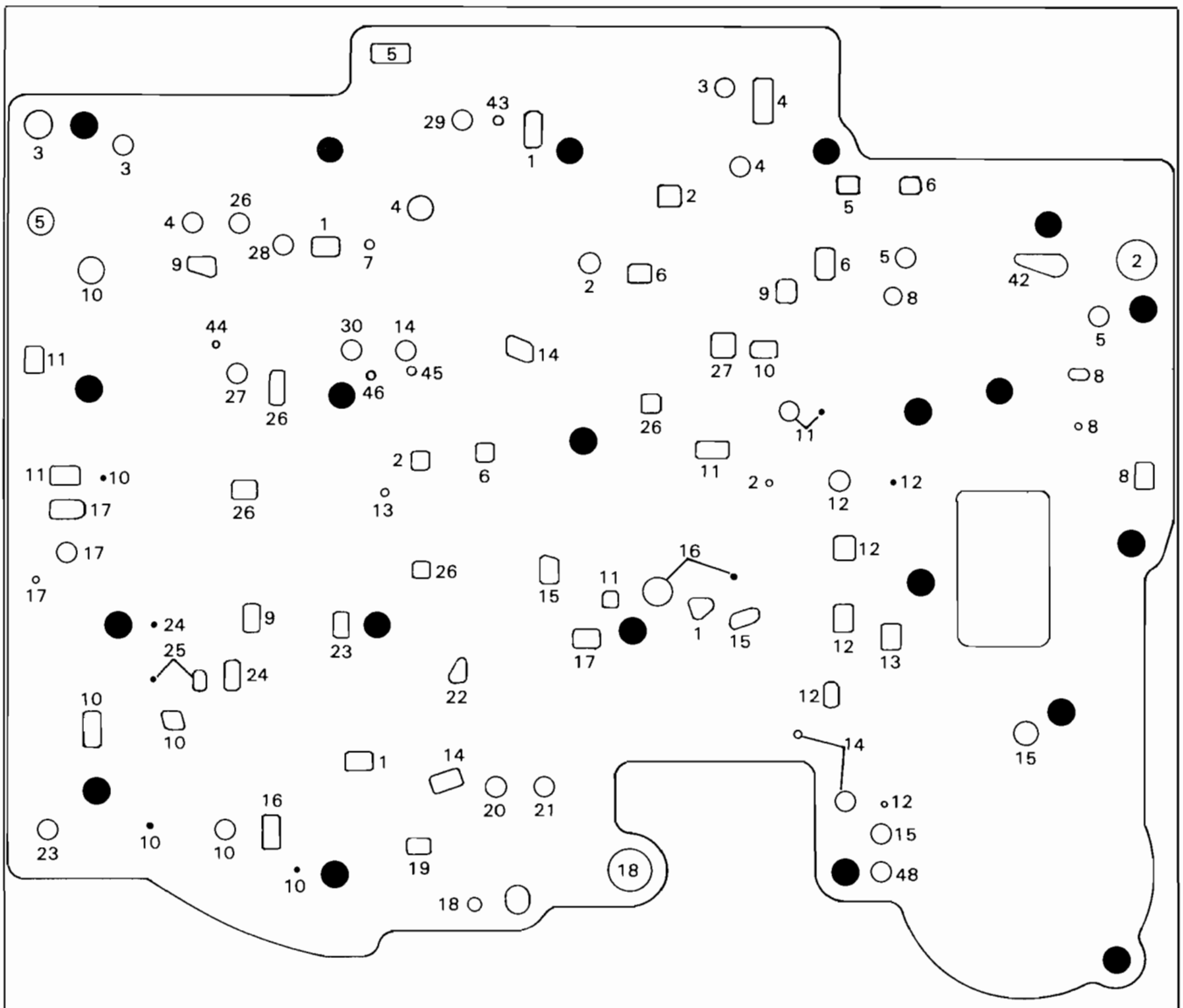
Figure 42 Valve Body Oil Passages



A THROTTLE VALVE
B T.V. PLUNGER & BUSHING
C 4-3 SEQUENCE VALVE
D 3-4 RELAY VALVE
E T.V. LIMIT VALVE TRAIN
F ACCUMULATOR VALVE TRAIN
G LINE BIAS VALVE TRAIN
H 3-2 CONTROL VALVE TRAIN
I MANUAL VALVE
J 1-2 SHIFT VALVE TRAIN
K 2-3 SHIFT VALVE TRAIN
L 3-4 SHIFT VALVE TRAIN
M CONVERTER CLUTCH SHIFT VALVE TRAIN
N M.T.V. UP VALVE TRAIN
O M.T.V. DOWN VALVE TRAIN
P CONVERTER CLUTCH T.V. BUSHING BORE PLUG (ECM CONTROLED VEHICLES)
Q CONVERTER CLUTCH SHIFT VALVE BORE PLUG (ECM CONTROLED VEHICLES)

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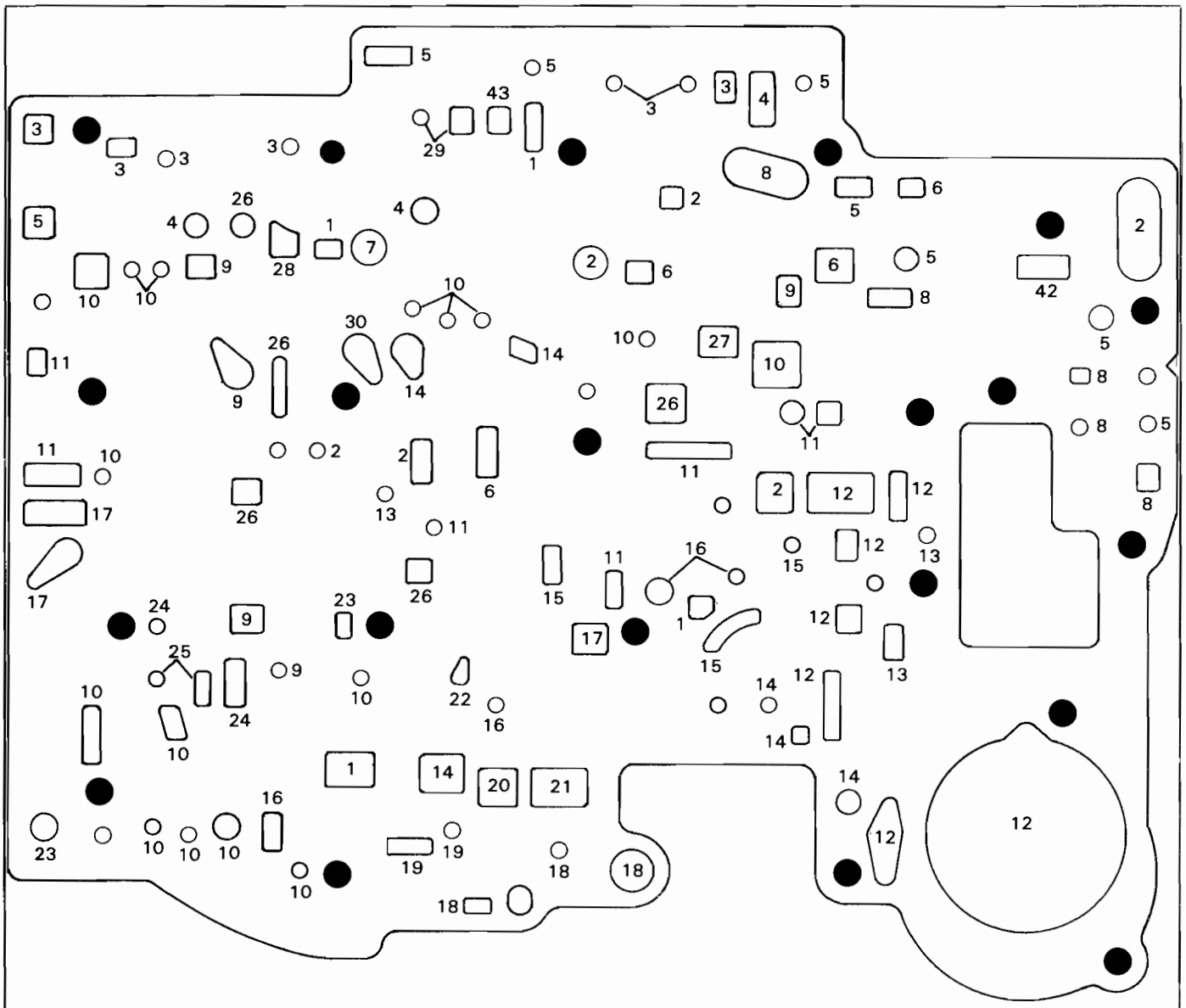
Figure 43 Valve Trains



1 LINE
2 D4
3 D2
4 LO
5 REVERSE
6 GOVERNOR
7 LO - 1ST FEED
8 LO/REVERSE
9 3RD ACCUMULATOR
10 T.V.
11 M.T.V.
12 ACCUMULATOR
13 4TH SIGNAL
14 2ND CLUTCH
15 3-4 ACCUMULATOR
16 T.V.F.
17 OVERRUN CLUTCH
18 T.V. EX.
19 D3/PART THROTTLE
20 PART THROTTLE
21 D3
22 4TH CLUTCH
23 C.C. SIG.
24 MOD. UP
25 MOD. DOWN
26 DETENT
27 3-4 CLUTCH
28 DETENT/LO
29 RND4-3
30 3RD CLUTCH
31 IDENTIFICATION
42 D4 ABUSE
43 3RD FEED
44 3-2 HIGH SPEED
45 2ND FEED
46 3RD CL. EXHAUST
47 4TH FEED
48 1-2 ACCUMULATOR

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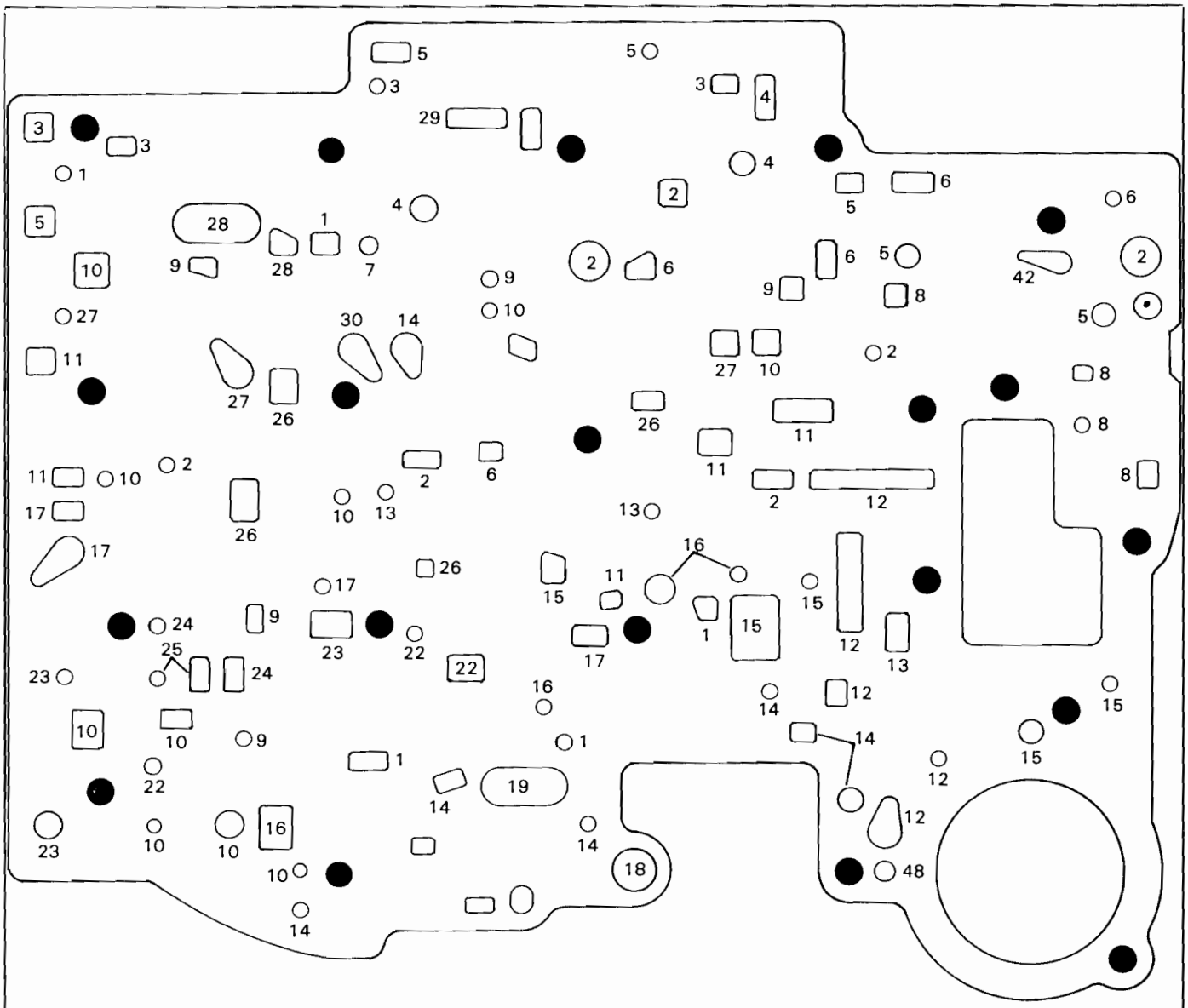
Figure 44 Typical Spacer Plate



1 LINE
2 D4
3 D2
4 LO
5 REVERSE
6 GOVERNOR
7 LO - 1ST FEED
8 LO/REVERSE
9 3RD ACCUMULATOR
10 T.V.
11 M.T.V.
12 ACCUMULATOR
13 4TH SIGNAL
14 2ND CLUTCH
15 3-4 ACCUMULATOR
16 T.V.F.
17 OVERRUN CLUTCH
18 T.V. EX.
19 D3/PART THROTTLE
20 PART THROTTLE
21 D3
22 4TH CLUTCH
23 C.C. SIG.
24 MOD. UP
25 MOD. DOWN
26 DETENT
27 3-4 CLUTCH
28 DETENT/LO
29 RND4-3
30 3RD CLUTCH
31 IDENTIFICATION
42 D4 ABUSE
43 3RD FEED
44 3-2 HIGH SPEED
45 2ND FEED
46 3RD CL. EXHAUST
47 4TH FEED
48 1-2 ACCUMULATOR

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Figure 45 Spacer Plate to Valve Body Gasket



1 LINE
2 D4
3 D2
4 LO
5 REVERSE
6 GOVERNOR
7 LO - 1ST FEED
8 LO/REVERSE
9 3RD ACCUMULATOR
10 T.V.
11 M.T.V.
12 ACCUMULATOR
13 4TH SIGNAL
14 2ND CLUTCH
15 3-4 ACCUMULATOR
16 T.V.F.
17 OVERRUN CLUTCH
18 T.V. EX.
19 D3/PART THROTTLE
20 PART THROTTLE
21 D3
22 4TH CLUTCH
23 C.C. SIG.
24 MOD. UP
25 MOD. DOWN
26 DETENT
27 3-4 CLUTCH
28 DETENT/LO
29 RND4-3
30 3RD CLUTCH
31 IDENTIFICATION
42 D4 ABUSE
43 3RD FEED
44 3-2 HIGH SPEED
45 2ND FEED
46 3RD CL. EXHAUST
47 4TH FEED
48 1-2 ACCUMULATOR

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Figure 46 Spacer Plate to Case Gasket

1 LINE
2 D4
3 D2
4 LO
5 REVERSE
6 GOVERNOR
7 LO - 1ST FEED
8 LO/REVERSE
9 3RD ACCUMULATOR
10 T.V.
11 M.T.V.
12 ACCUMULATOR (4TH)
13 4TH SIGNAL
14 2ND CLUTCH
15 3-4 ACCUMULATOR
16 T.V.F.
17 OVERRUN CLUTCH
18 T.V. EX.
19 D3/PART THROTTLE
20 PART THROTTLE
21 D3
22 4TH CLUTCH
23 C.C. SIG.
24 MOD. UP
25 MOD. DOWN
26 DETENT
27 3-4 CLUTCH (3-2 EX)
28 DETENT/LO
29 RND4-3
48 1-2 ACCUMULATOR

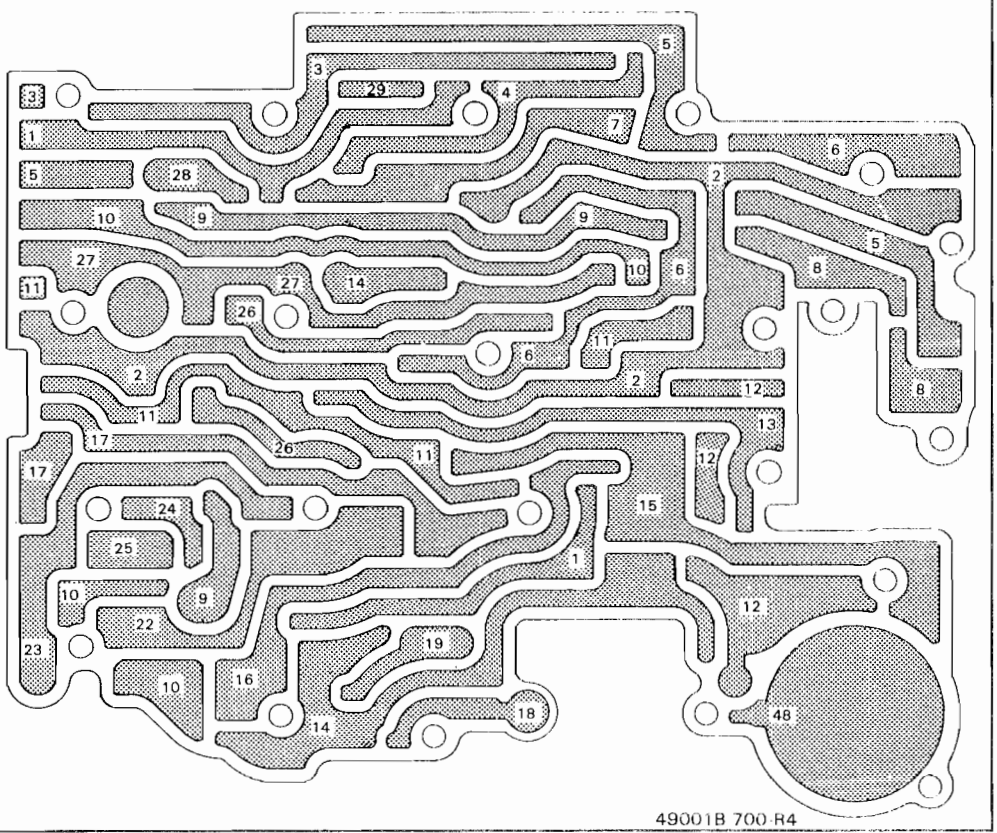
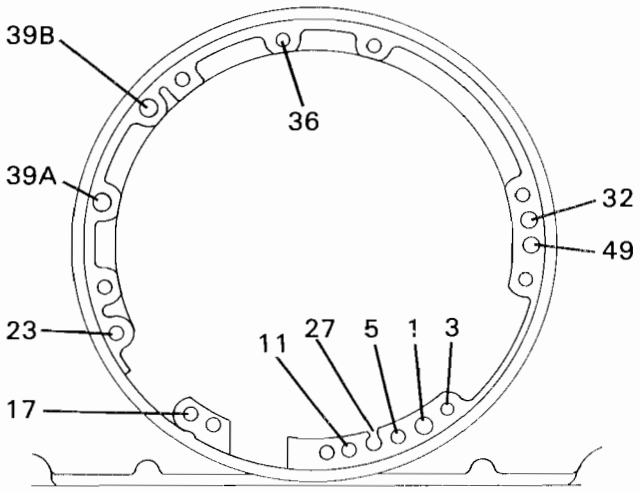


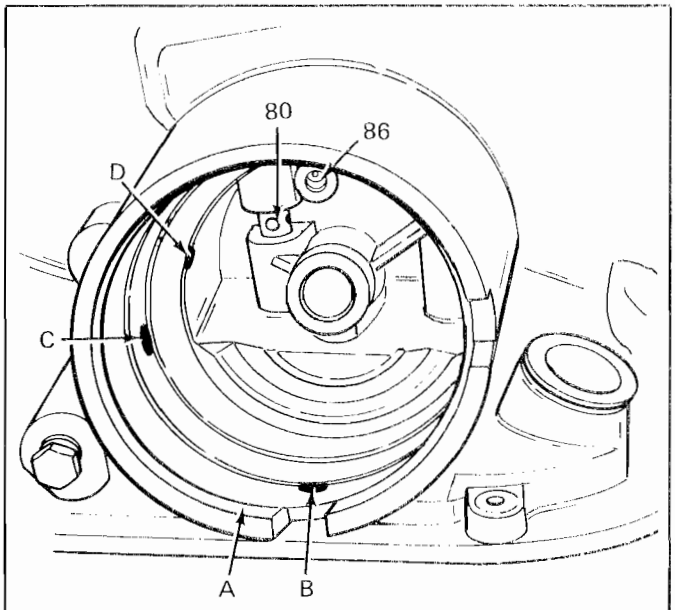
Figure 47 Case Oil Passages and Checkball Locations



1 LINE
3 DR-2
5 REVERSE
11 M.T.V.
17 O.R. CLUTCH
23 CONV. CL. SIG.
27 3-4 CLUTCH
32 VOID
36 VENT
39(a) LUBE TO COOLER
39(b) LUBE FROM COOLER
49 PRESSURE TAP

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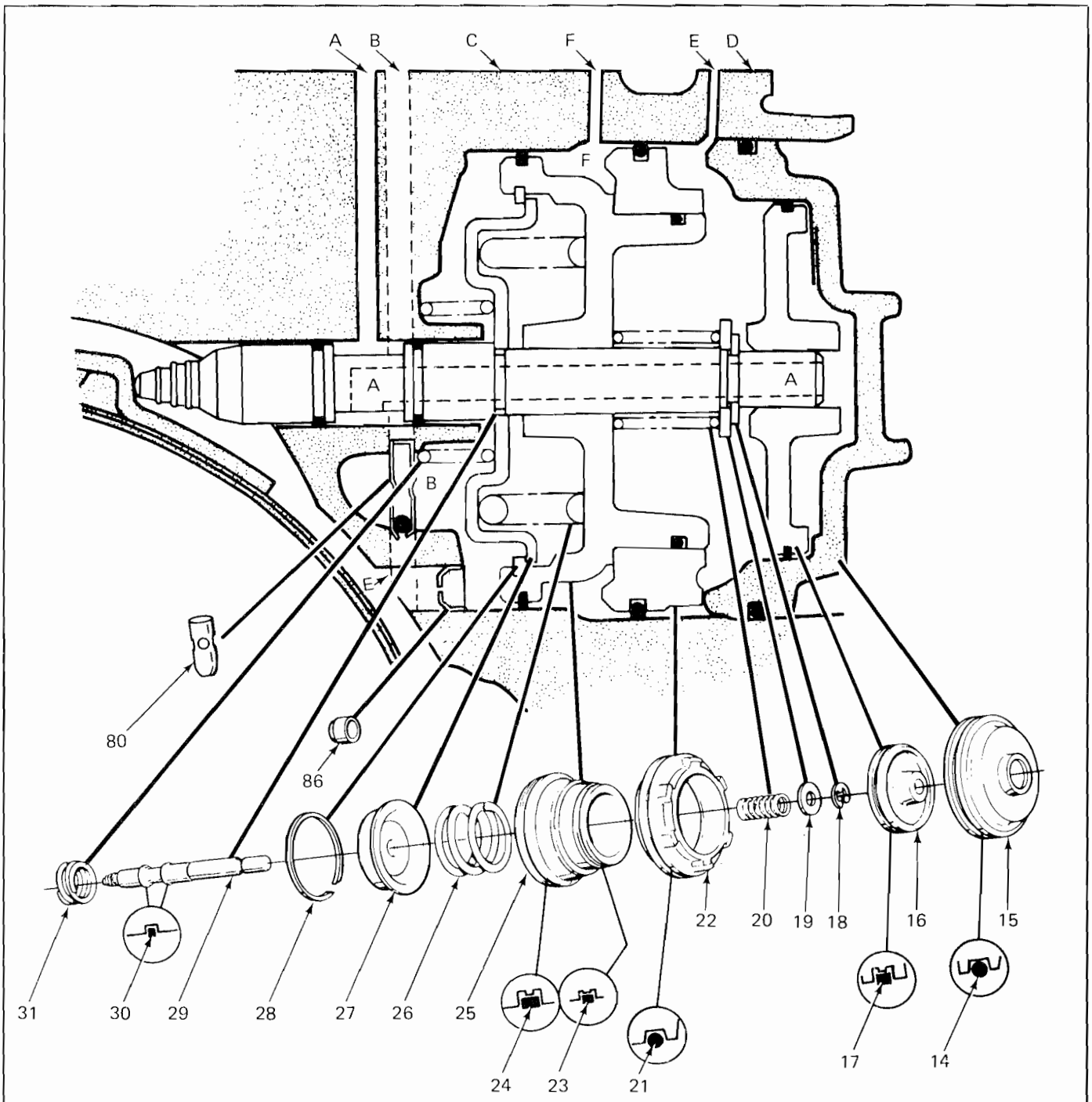
Figure 48 Pump to Case Oil Passages



A 2-4 SERVO BORE
B SERVO EXHAUST HOLE
C 2ND & 4TH BAND APPLY PASSAGE
D 3RD ACCUMULATOR PRESSURE TAP PASSAGE
80 RETAINER & BALL ASSEMBLY, 3RD ACCUM.
86 PLUG, CASE SERVO

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Figure 49 Servo Oil Passages



A 4TH OIL
B 3RD ACCUMULATOR OIL
C VALVE BODY FACE
D OIL PAN FLANGE
E EXHAUST
F 2ND OIL
14 SEAL, "O" RING (2-4 SERVO COVER)
15 COVER, 2-4 SERVO
16 PISTON, 4TH APPLY
17 RING, OIL SEAL OUTER (4TH APPLY PISTON)
18 RING, RETAINER (APPLY PIN)
19 WASHER, SERVO APPLY PIN
20 SPRING, SERVO APPLY PIN
21 SEAL, "O" RING
22 HOUSING, SERVO PISTON INNER
23 RING, OIL SEAL INNER (2ND APPLY PISTON)
24 RING, OIL SEAL OUTER (2ND APPLY PISTON)
25 PISTON, 2ND APPLY
26 SPRING, SERVO CUSHION
27 RETAINER, SERVO CUSHION SPRING
28 RING, RETAINER (2ND APPLY PISTON)
29 PIN, 2ND APPLY PISTON
30 SEAL, 2ND APPLY PISTON PIN
31 SPRING, SERVO RETURN
80 RETAINER & BALL ASSEMBLY, 3RD ACCUM.
86 PLUG, CASE SERVO

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Figure 50 Servo Assembly

1 LINE
3 D2
5 REVERSE
11 MODULATED T.V.
17 OVERRUN CLUTCH
23 CONVERTER CLUTCH SIGNAL
27 3-4 CLUTCH
32 VOID
33 EXHAUST
33(a) EXHAUST (T.C.C. RELEASE)
33(b) EXHAUST (PRESS. REG.)
36 VENT
37 DECREASE
38 SEAL DRAIN
39 LUBE
39(a) LUBE TO COOLER
39(b) LUBE FROM COOLER
40 CONVERTER CLUTCH RELEASE
41 CONVERTER CLUTCH FEED

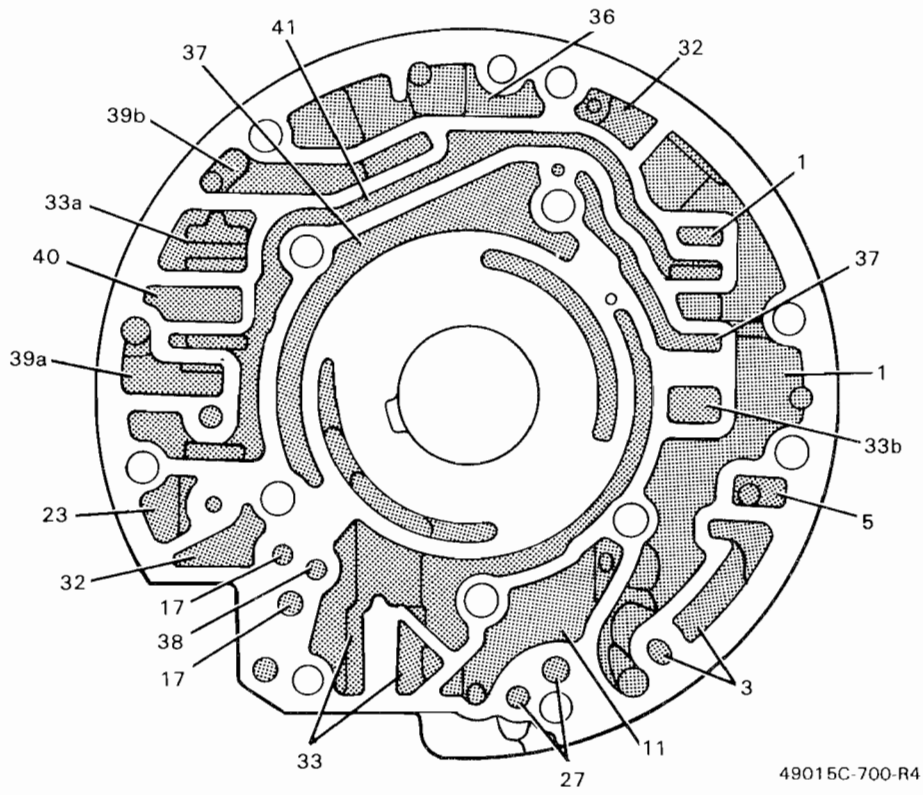


Figure 51 Pump Cover Oil Passages

1 LINE
3 D2
5 REVERSE
11 MODULATED T.V.
17 OVERRUN CLUTCH
23 CONVERTER CLUTCH SIGNAL
27 3-4 CLUTCH
32 VOID
33 EXHAUST
33(a) EXHAUST (T.C.C. RELEASE)
33(b) EXHAUST (PRESS. REG.)
36 VENT
37 DECREASE
38 SEAL DRAIN
39 LUBE
39(a) LUBE TO COOLER
39(b) LUBE FROM COOLER
40 CONVERTER CLUTCH RELEASE
41 CONVERTER CLUTCH FEED

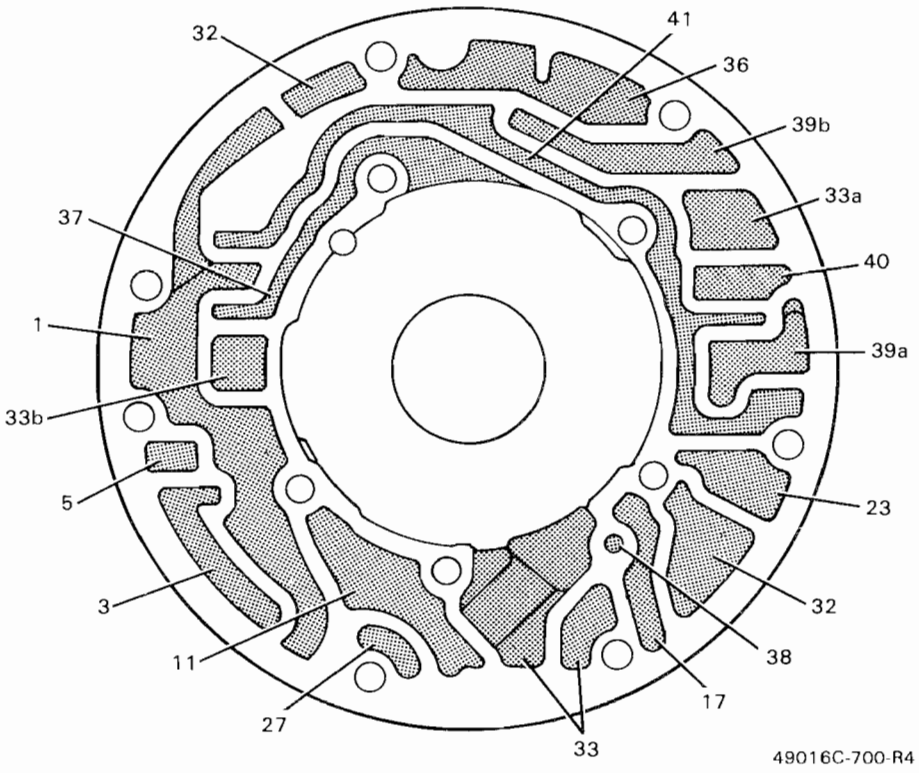


Figure 52 Pump Body Oil Passages

TORQUE CONVERTER CLUTCH (TCC) DIAGNOSIS

To properly diagnose the Torque Converter Clutch (TCC) system, perform all electrical testing first and then the hydraulic testing. Refer Torque Converter Section 6E2-C8 for additional information.

The TCC is applied by fluid pressure which is controlled by a solenoid located inside the Automatic Transmission assembly. The solenoid is energized or released by making or breaking an electrical circuit through a combination of switches and sensors.

TCC Electrical Diagnosis

- For electrical diagnosis of TCC, refer to the specific vehicle section in Section 8A, Electrical Diagnosis.
- For diagnosis of emission control related components of TCC, Refer to the specific section of 6E, Driveability and Emissions.
- For the diagnosis of TCC Hydraulic Controls, refer to the Procedure and Wiring Diagrams provided in this section.

Functional Check Procedure

Inspect

1. Install a tachometer
2. Operate the vehicle until proper operating temperature is reached
3. Drive vehicle at 50-55 mph (80-88 Km/h) with light throttle (road load)
4. Maintaining throttle lightly touch the brake pedal and check for a slight bump when the TCC releases and a slight increase in engine RPM.
5. Release the brake, slowly accelerate and check for a re-apply of the converter clutch and a slight decrease in engine RPM.

Preliminary Checking Procedure

The purpose of the preliminary checking procedure is to isolate external (electrical) problems from internal (electrical or mechanical) ones.

Important

- Use only a scale type ohmmeter. High impedance type ohmmeters and those with a digital readout will not work.
- An ALCL scanner may be used to verify the electrical circuit. Remember, a completed circuit does not indicate that the solenoid will apply.
- Do not bench test using an automotive type battery. Accidentally crossed wires will damage the internal diodes of the TCC solenoid.

External Controls

Inspect

- Connect voltmeter between transmission connector and ground.
- Turn key "ON"
- If 0 or low voltage is found, refer to Sections 6E and 8A for electrical diagnosis.
- If 12 volts are present at the connector, refer to the TCC hydraulic diagnosis.

TORQUE CONVERTER EVALUATION

Torque Converter Stator

The Torque Converter Stator roller clutch can have one of two different type malfunctions:

A. Stator Assembly freewheels in both directions.

B. Stator Assembly remains locked up at all times.

Condition A-Poor Acceleration Low Speed

The vehicle tends to have poor acceleration from a standstill. At speeds above 30-35 mph (50-55 km/h), the car may act normal. If poor acceleration is noted, it should first be determined that the exhaust system is not blocked, the engine timing is correct and the transmission is in first (1st) gear when starting out.

If the engine freely accelerates to high r.p.m. in "NEUTRAL" (N), it can be assumed that the engine and exhaust system are normal. Checking for poor performance in "Drive" and Reverse will help determine if the stator is freewheeling at all times.

Condition B-Poor Acceleration High Speed

Engine r.p.m. and car speed limited or restricted at high speeds. Performance when accelerating from a standstill is normal. Engine may over-heat. Visual examination of the converter may reveal a blue color from over-heating.

If the converter has been removed, the stator roller clutch can be checked by inserting a finger into the splined inner race of the roller clutch and trying to turn the race in both directions. The inner race should turn freely clockwise, but not turn or be very difficult to turn counterclockwise.

The Converter Should Be Replaced If:

- Leaks externally, such as at the hub weld area.
- Converter has an imbalance which cannot be corrected. (Refer to Converter Vibration Test Procedure).
- Converter is contaminated with engine coolant containing antifreeze.

The Converter Should Not Be Replaced If:

- The oil has an odor, is discolored, and there is no evidence of metal or clutch facing particles.
- The threads in one or more of the three converter bolt holes are damaged.
  - Correct with thread insert. (Refer to Section 6A)

SECTION 700-R4

MD8

AUTOMATIC TRANSMISSION UNIT REPAIR

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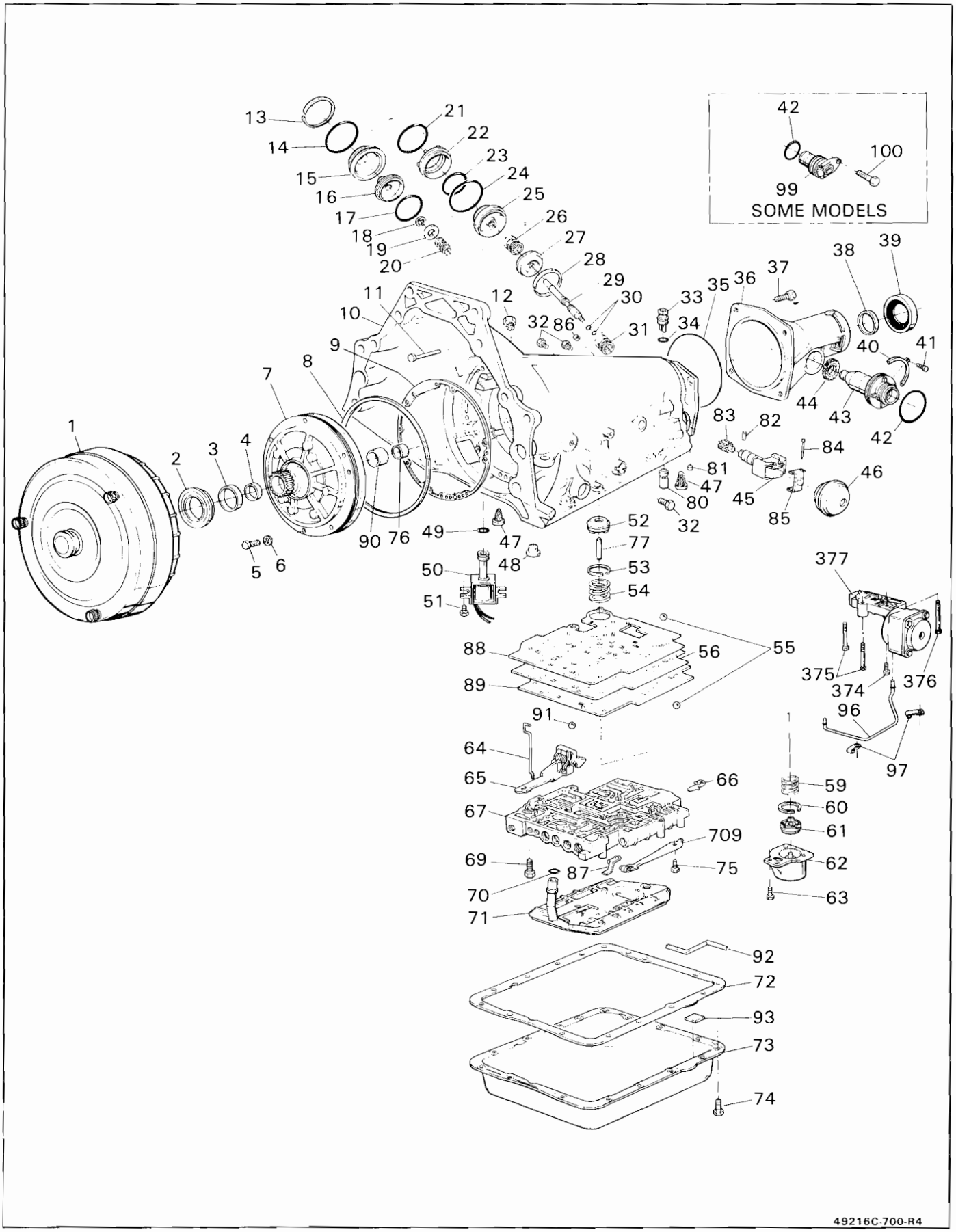


Figure 41 Case and External Parts

ILL. NO.	DESCRIPTION
1	CONVERTER ASSEMBLY
2	SEAL ASSEMBLY, OIL
3	BUSHING, OIL PUMP BODY
4	BUSHING, STATOR SHAFT (FRONT)
5	BOLT, PUMP TO CASE
6	WASHER, PUMP TO CASE BOLT
7	PUMP ASSEMBLY, OIL
8	SEAL, OIL (PUMP TO CASE)
9	GASKET, PUMP COVER TO CASE
10	CASE, TRANSMISSION
11	VENT ASSEMBLY, TRANSMISSION
12	CONNECTOR, OIL COOLER PIPE
13	RING, SERVO COVER RETAINING
14	SEAL, "O" RING (2-4 SERVO COVER)
15	COVER, 2-4 SERVO
16	PISTON, 4TH APPLY
17	RING, OIL SEAL (4TH APPLY PISTON) (OUTER)
18	RING, RETAINER (APPLY PIN)
19	WASHER, SERVO APPLY PIN
20	SPRING, SERVO APPLY PIN
21	SEAL, "O" RING
22	HOUSING, SERVO PISTON (INNER)
23	RING, OIL SEAL (2ND APPLY PISTON) (INNER)
24	RING, OIL SEAL (2ND APPLY PISTON) (OUTER)
25	PISTON, 2ND APPLY
26	SPRING, SERVO CUSHION
27	RETAINER, SERVO CUSHION SPRING
28	RING, RETAINER (2ND APPLY PISTON)
29	PIN, 2ND APPLY PISTON
30	SEAL, 2ND APPLY PISTON PIN
31	SPRING, SERVO RETURN
32	PLUG, PRESSURE
33	CONNECTOR, ELECTRICAL
34	SEAL, "O" RING (ELECTRICAL CONNECTION)
35	SEAL, CASE EXTENSION TO CASE
36	EXTENSION, CASE
37	BOLT, CASE EXTENSION TO CASE
38	BUSHING, CASE EXTENSION
39	SEAL ASSEMBLY, CASE EXTENSION OIL
40	RETAINER, SPEEDO DRIVEN GEAR FITTING
41	BOLT & WASHER ASSEMBLY
42	SEAL, "O" RING (SPEEDO FITTING TO CASE EXTENSION)
43	FITTING ASSEMBLY, SPEEDO DRIVEN GEAR
44	GEAR, SPEEDO DRIVEN
45	GOVERNOR ASSEMBLY
46	COVER, GOVERNOR
47	SCREEN, TRANSMISSION OIL PRESSURE (CONVERTER & GOVERNOR)
48	PIN, BAND ANCHOR
49	SEAL, "O" RING (SOLENOID)
50	SOLENOID ASSEMBLY
51	BOLT, HEX WASHER HEAD (SOLENOID)
52	PISTON, 3-4 ACCUMULATOR
53	RING, OIL SEAL (3-4 ACCUMULATOR PISTON)
54	SPRING, 3-4 ACCUMULATOR
55	BALL, .25 DIAMETER
56	PLATE, VALVE BODY SPACER
59	SPRING, 1-2 ACCUMULATOR
60	RING, OIL SEAL (1-2 ACCUMULATOR PISTON)
61	PISTON, 1-2 ACCUMULATOR
62	COVER & PIN ASSEMBLY, 1-2 ACCUM.
63	BOLT, ACCUMULATOR COVER
64	LINK, THROTTLE LEVER TO CABLE
65	LEVER & BRACKET ASSEMBLY, THROTTLE
66	CLIP, ELECTRICAL WIRE
67	VALVE ASSEMBLY, CONTROL BODY
69	BOLT, VALVE BODY
70	SEAL, "O" RING FILTER
71	FILTER ASSEMBLY, TRANSMISSION OIL
72	GASKET, TRANSMISSION OIL PAN
73	PAN, TRANSMISSION OIL
74	SCREW, SPEC. HEX WASHER HEAD (PAN)
75	BOLT, MANUAL DETENT SPRING
76	BUSHING, CASE
77	PIN, ACCUMULATOR PISTON
80	RETAINER & BALL ASSEMBLY, 3RD ACCUMULATOR
81	PLUG, TRANSMISSION CASE (ACCUMULATOR BLEED)
82	PIN, GOVERNOR GEAR RETAINER
83	GEAR, GOVERNOR DRIVEN
84	PIN, GOVERNOR WEIGHT
85	CAP, GOVERNOR THRUST
86	PLUG, CASE SERVO
87	CLIP, FILTER RETAINER
88	GASKET, SPACER PLATE TO CASE
89	GASKET, SPACER PLATE TO VALVE BODY
90	BUSHING, STATOR SHAFT (REAR)
91	BALL, CARBON STEEL (T.V. EXHAUST)
92	CONDUIT, SOLENOID WIRE
93	MAGNET, CHIP COLLECTOR
96	TUBE, AUXILIARY ACCUMULATOR VALVE
97	CLAMP, TUBE
99	SPEED SENSOR, INTERNAL TRANSMISSION
100	BOLT, SPEEDO SENSOR RETAINING
374	BOLT, SPECIAL HEX HEAD (M6 X 1 X 16)
375	BOLT, HEX HEAD (M6 X 1 X 35)
376	BOLT, HEX HEAD (M6 X 1 X 45)
377	AUXILIARY ACCUMULATOR VALVE BODY ASSEMBLY
709	SPRING ASSEMBLY, MANUAL DETENT

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Figure 41L

TRANSMISSION DISASSEMBLY

General Service Information

- Teflon Oil Seal Rings
  If any seal rings are damaged, cut, or do not rotate freely in their groove be certain to check the ring groove for debris, burrs, or damage.
- Thrust Washer Surfaces
  The thrust washer and thrust bearing surfaces may appear to be polished. This is a normal condition and should not be considered damage.

Clean

- Thoroughly clean the exterior of the transmission.

Remove or Disconnect

- Torque Converter (1)

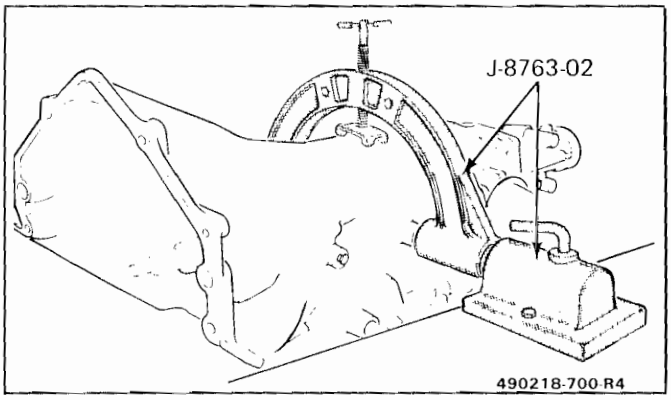


Figure 42 Holding Fixture

Install or Connect (Figure 42)

Tools Required:
J-8763-02 Holding Fixture and Base

1. J-8763-02 onto the transmission case.
2. Holding fixture into the base.

Remove or Disconnect

- Drain the transmission fluid.

2-4 Servo Assembly

Remove or Disconnect (Figures 41, 41L, and 43)

TOOLS REQUIRED:
J-29714 Servo Cover Compressor

1. Install J-29714.
2. Servo cover retaining ring (13)
3. Servo cover and "O" ring seal (14 and 15)
4. 2-4 servo assembly (16-31)

Servo Pin Length

As a diagnostic aid, the servo pin length should now be checked. If the pin length is too short or too long be certain to inspect the 2-4 band and reverse input drum for damage or wear when disassembled.

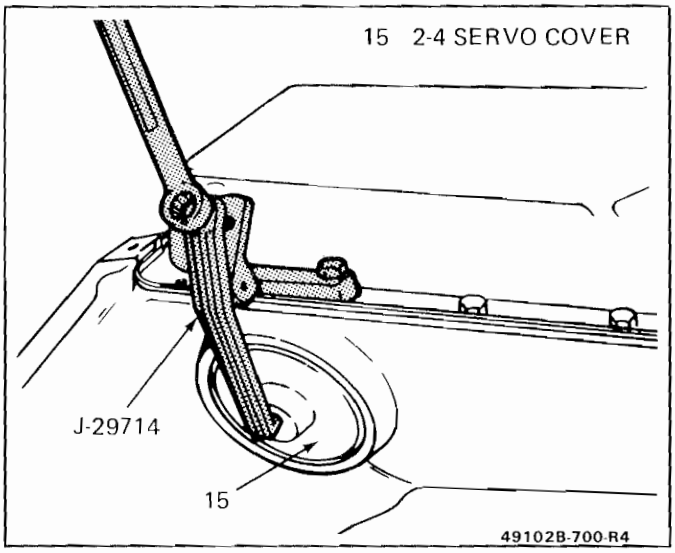


Figure 43 Servo Cover Removal

Remove or Disconnect (Figures 43, 44, 45, 46)

TOOLS REQUIRED:
J-22269-01 Piston Compressor

1. 4th apply piston (16)
2. Servo return spring (31)
3. Servo pin retainer ring (18), washer (19), and apply pin spring (20)
4. 2nd apply piston pin (29).
5. Install J-22269-01.
6. Retainer ring (28)
7. Cushion spring retainer (27) and cushion spring (26)

Measure (Figure 47)

TOOLS REQUIRED:
J-33037 Band Apply Pin Tool

1. Install J-33037 as shown with apply pin (29).
2. Apply 11 N·m (100 in. lbs.) torque.
3. If white line "A" appears in gage slot "B" pin length is correct.
4. Use pin selection chart to determine correct pin length.

Governor and Extension

Remove or Disconnect (Figure 48)

1. Governor cover (46)
   - tap around the cover flange with a punch to remove
   - DO NOT DAMAGE THE GOVERNOR COVER
2. Governor assembly (45)
   Mechanical Speedometer:
3. Bolt and washer assembly (41) and retainer (40)
4. Speedometer driven gear assembly (43), speedo driven gear (44) and o-ring seal (42)
   Internal Transmission Speed Sensor (I.T.S.S.)

3. Bolt and washer assembly (41)
4. Speed Sensor assembly (99) and o-ring seal (42)
5. Case extension bolts (37) and case extension (36)
6. Extension seal ring (35)
7. Output shaft sleeve (690) and output shaft o-ring seal (691)
   - Not all models use an output shaft sleeve and seal

Remove or Disconnect (Figure 48)

Models with Mechanical Speedometer

1. Speedometer drive gear (689) and clip (688)
   - push tab of retaining clip and tap speedometer gear off the output shaft.
   - use care not to damage the speedo gear

Valve Body and Wiring Harness

Remove or Disconnect (Figures 49, 50)

1. Bolts (74), oil pan (73), and gasket (72).
2. Oil filter (71) and o-ring seal (70).
   - o-ring ring seal may be stuck in the case
3. Outside electrical connector (33) and o-ring seal (34).
4. Electrical connections from switches.
   - refer to wiring diagrams in the Hydraulic Diagnosis Section for specific model applications

5 Solenoid bolts (51) and solenoid assembly (50) with o-ring seal (49) and wiring harness.

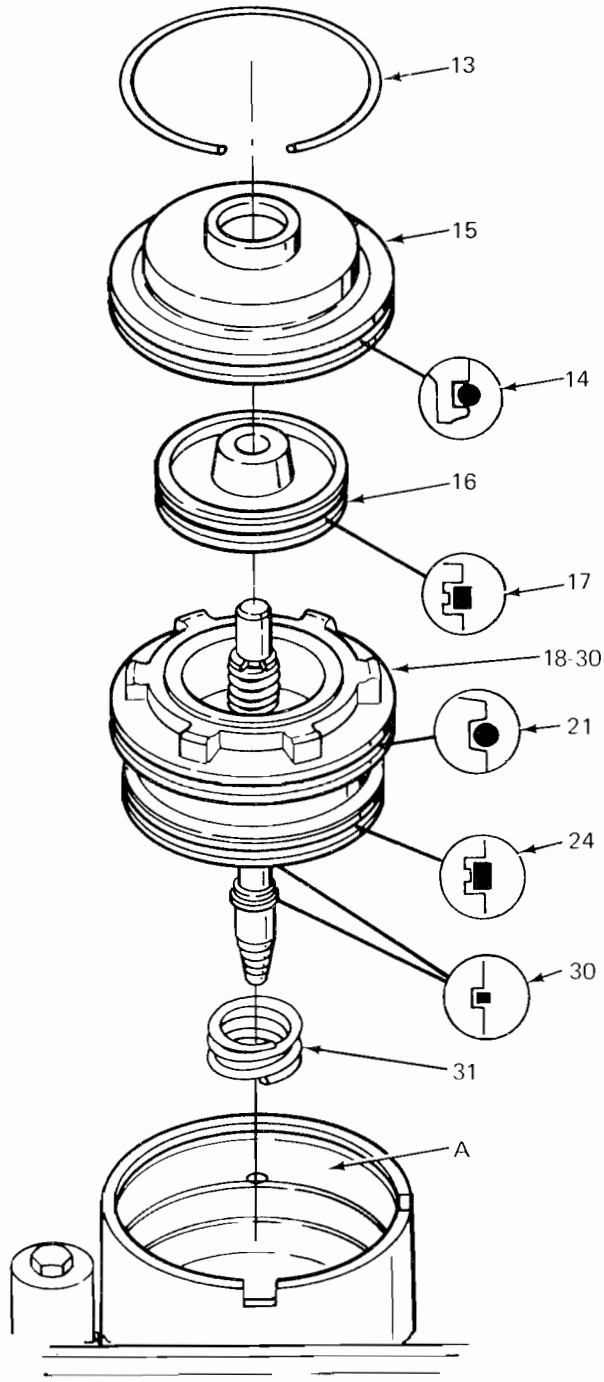
6. Accumulator cover bolts (63) and 1-2 accumulator cover and pin assembly (62).
7. 1-2 accumulator piston (61) and seal (60).
8. Spring (59).

Remove or Disconnect (Figures 51, 52, 53)

1. Bolt (75) and manual detent spring assembly (709).
2. Electrical wire clips (66) and tube clamps (97).
3. Auxiliary valve tube (96).
4. Wiring harness retaining washer (A) and the filter retainer clips (87).
5. Bolts (69) and T.V. lever and bracket assembly (65)
6. T.V. link (64)

Remove or Disconnect (Figures 51, 53 and 53A)

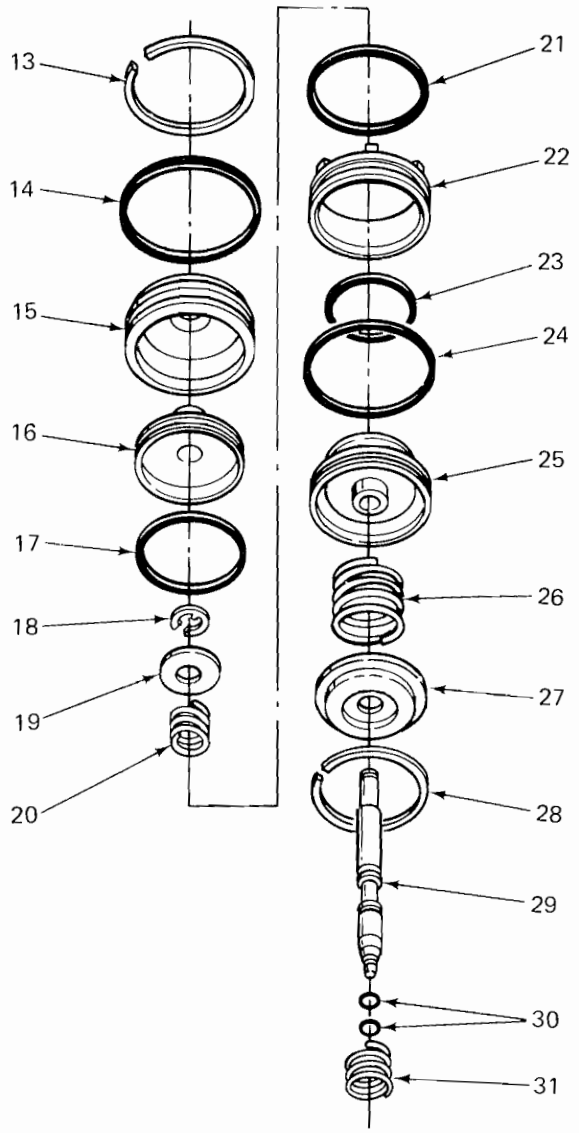
1. Remaining valve body bolts (69)
2. Manual valve link (705)
3. Control valve assembly (67)
4. Bolts (374-376), auxiliary valve body (377), and check ball (55)



A CASE SERVO BORE
13 RING, SERVO COVER RETAINING
14 SEAL, "O" RING (2-4 SERVO COVER)
15 COVER, 2-4 SERVO
16 PISTON, 4TH APPLY
17 RING, OIL SEAL OUTER (4TH APPLY PISTON)
18-30 2ND APPLY PISTON ASSEMBLY
21 SEAL, "O" RING
24 RING, OIL SEAL OUTER (2ND APPLY PISTON)
30 SEAL, 2ND APPLY PISTON PIN
31 SPRING, SERVO RETURN

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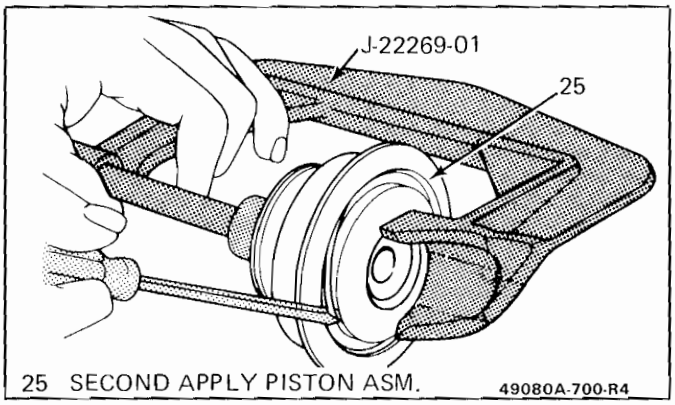
Figure 44 Servo Removal



13 RING, SERVO COVER RETAINING
14 SEAL, "O" RING (2-4, SERVO COVER)
15 COVER, 2-4 SERVO
16 PISTON, 4TH APPLY
17 RING, OIL SEAL OUTER (4TH APPLY PISTON)
18 RING, RETAINER (APPLY PIN)
19 WASHER, SERVO APPLY PIN
20 SPRING, SERVO APPLY PIN
21 SEAL, "O" RING
22 HOUSING, SERVO PISTON INNER
23 RING, OIL SEAL INNER (2ND APPLY PISTON)
24 RING, OIL SEAL OUTER (2ND APPLY PISTON)
25 PISTON, 2ND APPLY
26 SPRING, SERVO CUSHION
27 RETAINER, SERVO CUSHION SPRING
28 RING, RETAINER (2ND APPLY PISTON)
29 PIN, 2ND APPLY PISTON
30 SEAL, 2ND APPLY PISTON PIN
31 SPRING, SERVO RETURN

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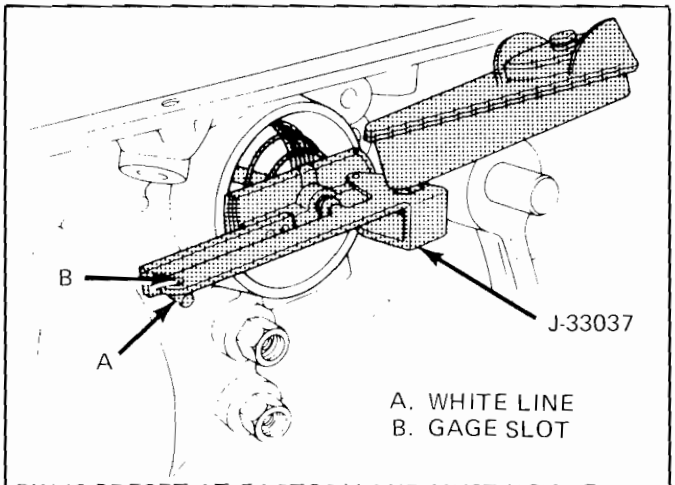
Figure 45 Servo Assembly



25 SECOND APPLY PISTON ASM.

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Figure 46 Second Servo Piston Retaining Ring Removal



A. WHITE LINE
B. GAGE SLOT

PIN IS PRESET AT FACTORY AND MUST NOT BE READJUSTED

2-4 SERVO PIN SELECTION

PIN LENGTH		PIN I.D.
mm	INCH	
66.37-66.67	2.61-2.62	2 RINGS
67.74-68.04	2.67-2.68	3 RINGS
69.11-69.41	2.72-2.73	WIDE BAND

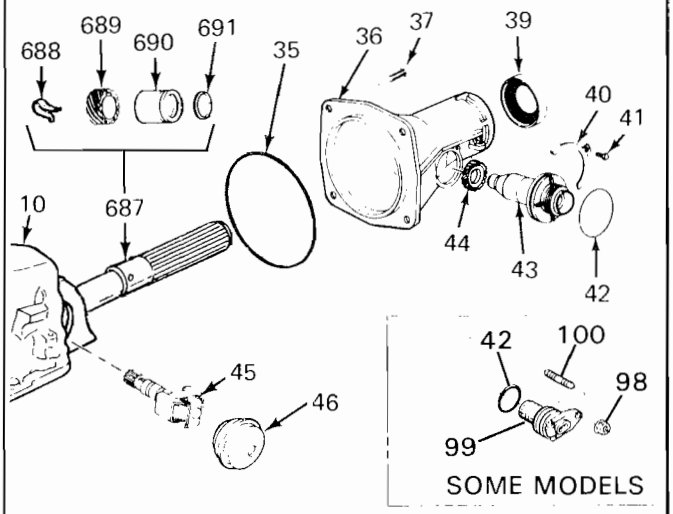
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Figure 47 Servo Pin Length

5. Spacer plate (56) and spacer plate gaskets (88 and 89)
6. Check balls (55 and 91) spring (54), piston (52), seal (53) and pin
   - Three are located under the valve body and five are located in the case. The large copper flash colored ball is #10 check ball (91)

Transmission End Play Check

As a diagnostic aid transmission end play should be checked prior to removing the internal parts. If the end play is not within specifications you should watch for possible worn or misassembled parts during disassembly.



10 CASE, TRANSMISSION
35 SEAL, CASE EXTENSION TO CASE
36 EXTENSION, CASE
37 BOLT, CASE EXTENSION TO CASE
39 SEAL ASSEMBLY, CASE EXTENSION OIL
40 RETAINER, SPEEDO DRIVEN GEAR FITTING
41 BOLT & WASHER ASSEMBLY
42 SEAL, "O" RING (SPEEDO FITTING TO CASE EXTENSION)
43 FITTING ASSEMBLY, SPEEDO DRIVEN GEAR
44 GEAR, SPEEDO DRIVEN
45 GOVERNOR ASSEMBLY
46 COVER, GOVERNOR
98 NUT, FLANGED HEX
99 SPEED SENSOR, INTERNAL TRANSMISSION
100 STUD, DOUBLE END
687 SHAFT, OUTPUT
688 CLIP, SPEEDO DRIVE GEAR
689 GEAR, SPEEDO DRIVE
690 SLEEVE, OUTPUT SHAFT — NOT USED ON ALL MODELS
691 SEAL, OUTPUT SHAFT — NOT USED ON ALL MODELS

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Figure 48 Extension and Associated Parts

Tighten (Figures 56 and 57)

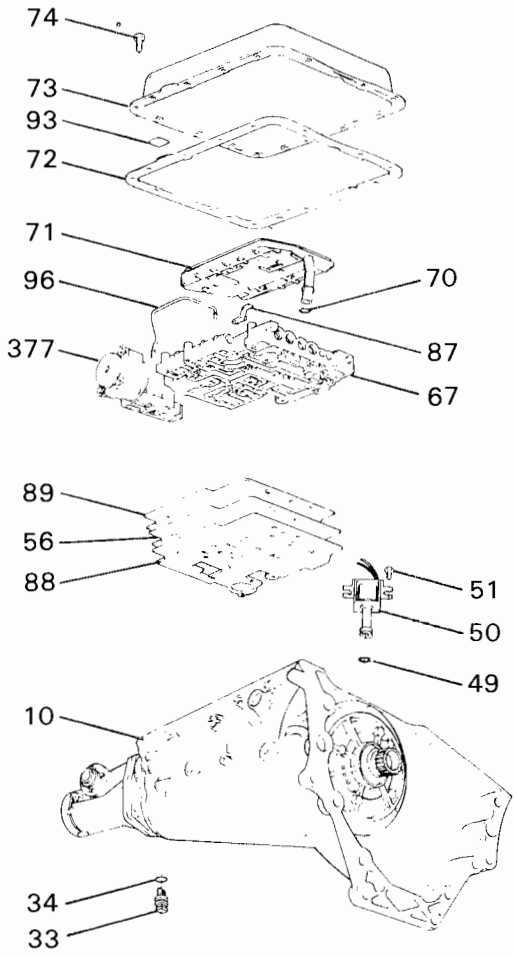
TOOLS REQUIRED:
J-24773-A Oil Pump Remover
J-25022-A End Play Adaptor (245 mm)
J-34725 End Play Adaptor (298 mm)
J-25025-7A Post
Dial Indicator

1. Remove an oil pump bolt (5) and install a 278 mm (11 in.) bolt and locknut or J-25025-7A.
2. Install J-25022-A or J-34725 as shown.
3. Install J-24773-A as shown.
4. Install dial indicator.
   - set to zero
   - pull up on J-24773-A
   - end play should be 0.13/0.92 mm (.005/.036 in.).

Oil Pump Assembly

Remove or Disconnect (Figures 59 and 60)

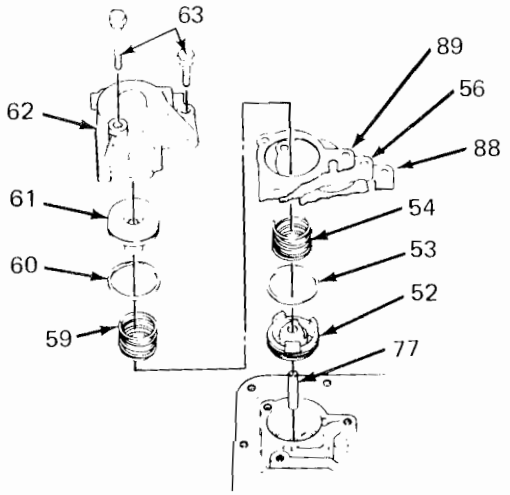
TOOLS REQUIRED:
J-24773-A Oil Pump Remover



ILL. NO.	DESCRIPTION
10	CASE, TRANSMISSION
33	CONNECTOR, ELECTRICAL
34	SEAL, "O" RING (ELECTRICAL CONNECTION)
49	SEAL, "O" RING (SOLENOID)
50	SOLENOID ASSEMBLY
51	BOLT, HEX WASHER HEAD (SOLENOID)
56	PLATE, VALVE BODY SPACER
67	ALVE ASSEMBLY, CONTROL BODY
70	SEAL, "O" RING FILTER
71	FILTER ASSEMBLY, TRANSMISSION OIL
72	GASKET, TRANSMISSION OIL PAN
73	PAN, TRANSMISSION OIL
74	SCREW, SPEC. HEX WASHER HEAD (PAN)
87	CLIP, FILTER RETAINER
88	GASKET, SPACER PLATE TO CASE
89	GASKET, SPACER PLATE TO VALVE BODY
93	MAGNET, CHIP COLLECTOR
96	TUBE, AUXILIARY ACCUMULATOR VALVE
377	AUXILIARY ACCUM. VALVE BODY ASM.

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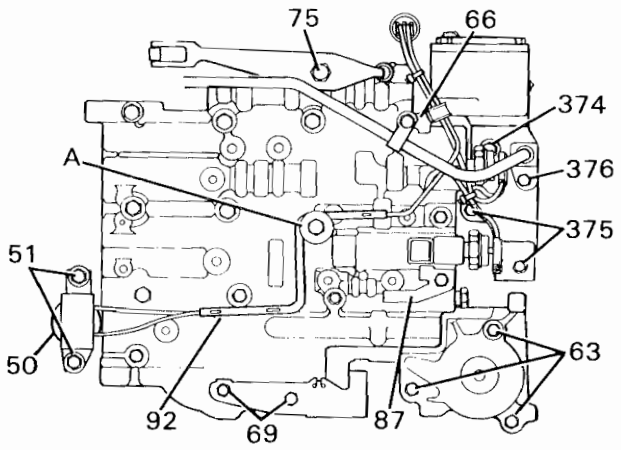
Figure 49 Case and Attaching Parts



52 PISTON, 3-4 ACCUMULATOR
53 RING, OIL SEAL (3-4 ACCUMULATOR PISTON)
54 SPRING, 3-4 ACCUMULATOR
56 PLATE, VALVE BODY SPACER
59 SPRING, 1-2 ACCUMULATOR
60 RING, OIL SEAL (1-2 ACCUMULATOR PISTON)
61 PISTON, 1-2 ACCUMULATOR
62 COVER & PIN ASSEMBLY, 1-2 ACCUMULATOR
63 BOLTS, ACCUMULATOR COVER
77 PIN, ACCUMULATOR PISTON
88 GASKET, SPACER PLATE TO CASE
89 GASKET, SPACER PLATE TO VALVE BODY

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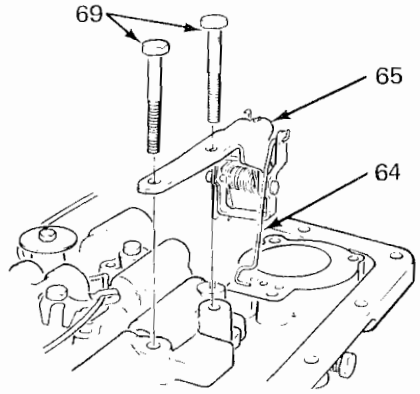
Figure 50 Accumulator Assembly



A WASHER WIRE RETAINER
50 SOLENOID ASSEMBLY
51 BOLT, HEX WASHER HEAD (SOLENOID)
63 BOLT, ACCUMULATOR COVER
66 CLIP, ELECTRICAL WIRE
69 BOLT, VALVE BODY
75 BOLT, MANUAL DETENT SPRING
87 CLIP, FILTER RETAINER
92 CONDUIT, SOLENOID WIRE
374 BOLT, SPEC. HEX WASHER HEAD (M6 X 1 X 16)
375 BOLT, HEX HEAD (M6 X 1 X 35)
376 BOLT, HEX HEAD (M6 X 1 X 45)

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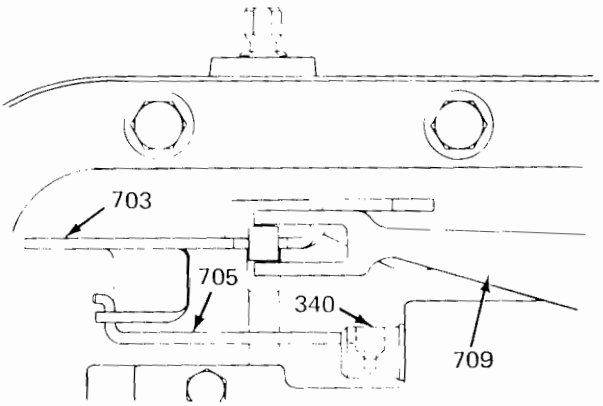
Figure 51 Valve Body Bolt Locations



64 LINK, THROTTLE LEVER TO CABLE
65 LEVER & BRACKET ASSEMBLY, THROTTLE
69 BOLTS, CONTROL VALVE ASSEMBLY

49249A-700-R4

Figure 52 T.V. Lever and Bracket



340 MANUAL VALVE
703 INNER DETENT LEVER
705 MANNUAL VALVE LINK
709 MANUAL DETENT SPRING ASSEMBLY

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Figure 53 Manual Valve Link

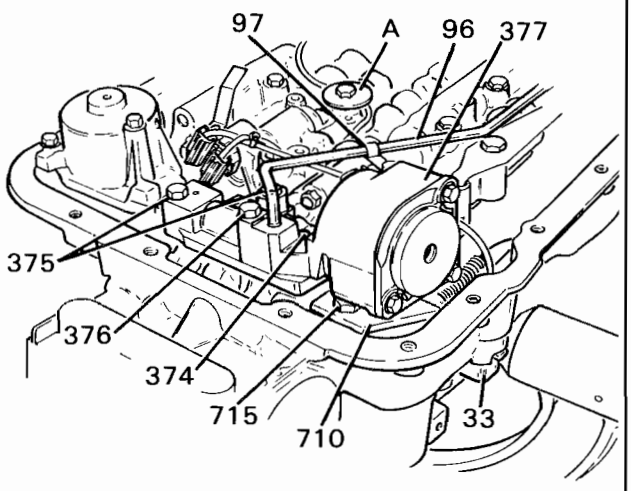
1. "O" ring seal (618)
2. All oil pump bolts (5) and washers (6)
3. Oil pump assembly (7) with J-24773-A
4. Oil pump to case seal (8) and gasket (9)
5. Reverse input clutch to oil pump thrust washer (601)

2-4 Band Reverse Input Clutch, Input Clutch and Input Gear Set

1. Reverse input clutch (605) and input clutch (62) together
   - (grasp the turbine shaft and lift)
2. Band assembly pin (48)
3. The 2-4 band assembly (602)
4. Input sun gear (658)

Install or Connect (Figure 61)

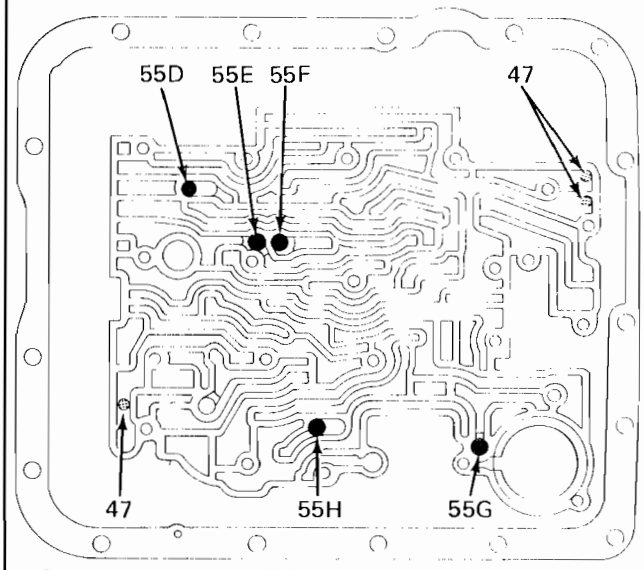
TOOLS REQUIRED:
J-29837 Output Shaft Support Fixture



A WASHER, WIRE RETAINING
33 CONNECTOR, ELECTRICAL
96 TUBE, AUXILIARY ACCUMULATOR VALVE
97 CLAMP, TUBE
374 BOLT, SPECIAL HEX HEAD (M6 X 1 X 16)
375 BOLT, HEX HEAD (M6 X 1 X 35)
376 BOLT, HEX HEAD (M6 X 1 X 45)
377 AUXILIARY ACCUM. VALVE BODY ASM.
710 BRACKET, PARKING LOCK
715 BOLT, PARKING LOCK BRACKET

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Figure 53A Removing Auxiliary Valve Body Assembly

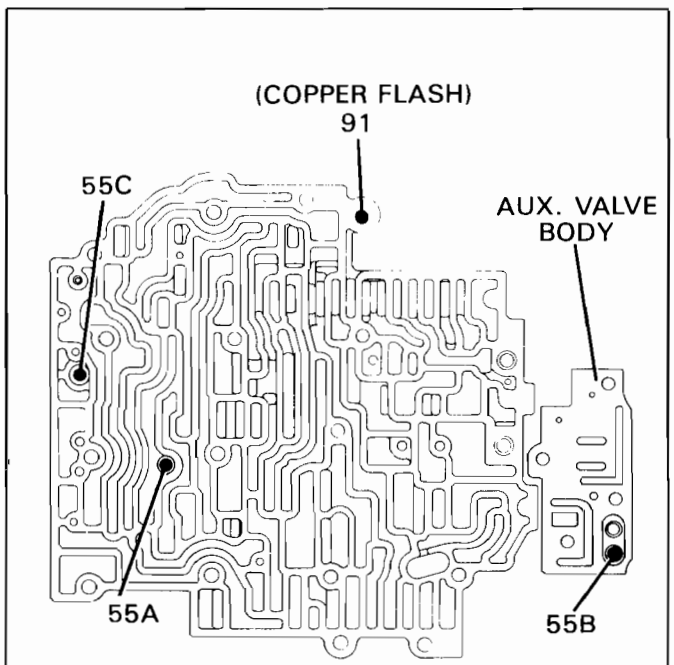


● CHECK BALL LOCATIONS ○ FILTER LOCATIONS

55D #9 CHECK BALL (DETENT/LO)
55E #4 CHECK BALL (3-4 CLUTCH/3-2 EX.)
55F #8 CHECK BALL (2ND/1-2)
55G #1 CHECK BALL (4TH ACCUMULATOR)
55H #3 CHECK BALL (PART THROTTLE/DRIVE 3)
47 GOVERNOR FILTER LOCATIONS
47 CONVERTER CLUTCH FILTER LOCATION

49243A-700-R4

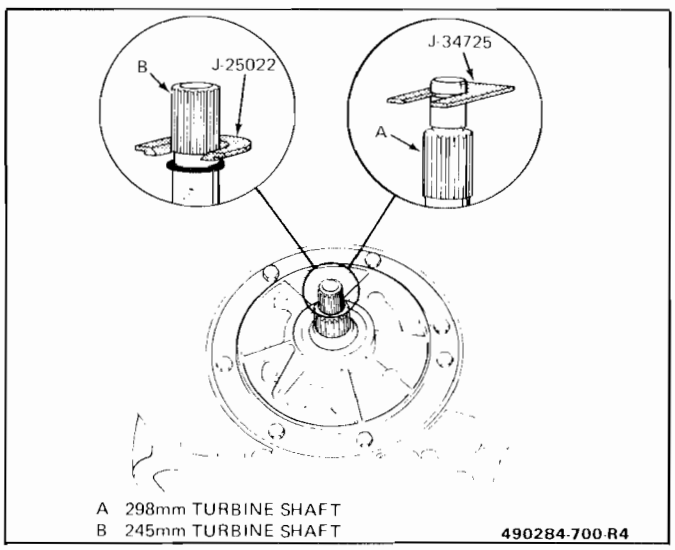
Figure 55 Case Checkballs and Filters



55A #2 CHECKBALL (3RD CLUTCH ACCUM.)
55B #5 CHECKBALL (FORWARD CLUTCH)
55C #6 CHECKBALL (DRIVE 3)
91 #10 CHECKBALL (T.V. EXHAUST)

49002D-700-R4

Figure 54 Valve Body Checkballs



A 298mm TURBINE SHAFT
B 245mm TURBINE SHAFT

490284-700-R4

Figure 56 End Play Tool

- J-29837 as shown

Important

- Output shaft (687) may fall free when input carrier retaining ring (661) is removed if J-29837 is not used.

Remove or Disconnect (Figures 58, 58L and 62)

TOOLS REQUIRED:

J-34627 Snap Ring Pliers

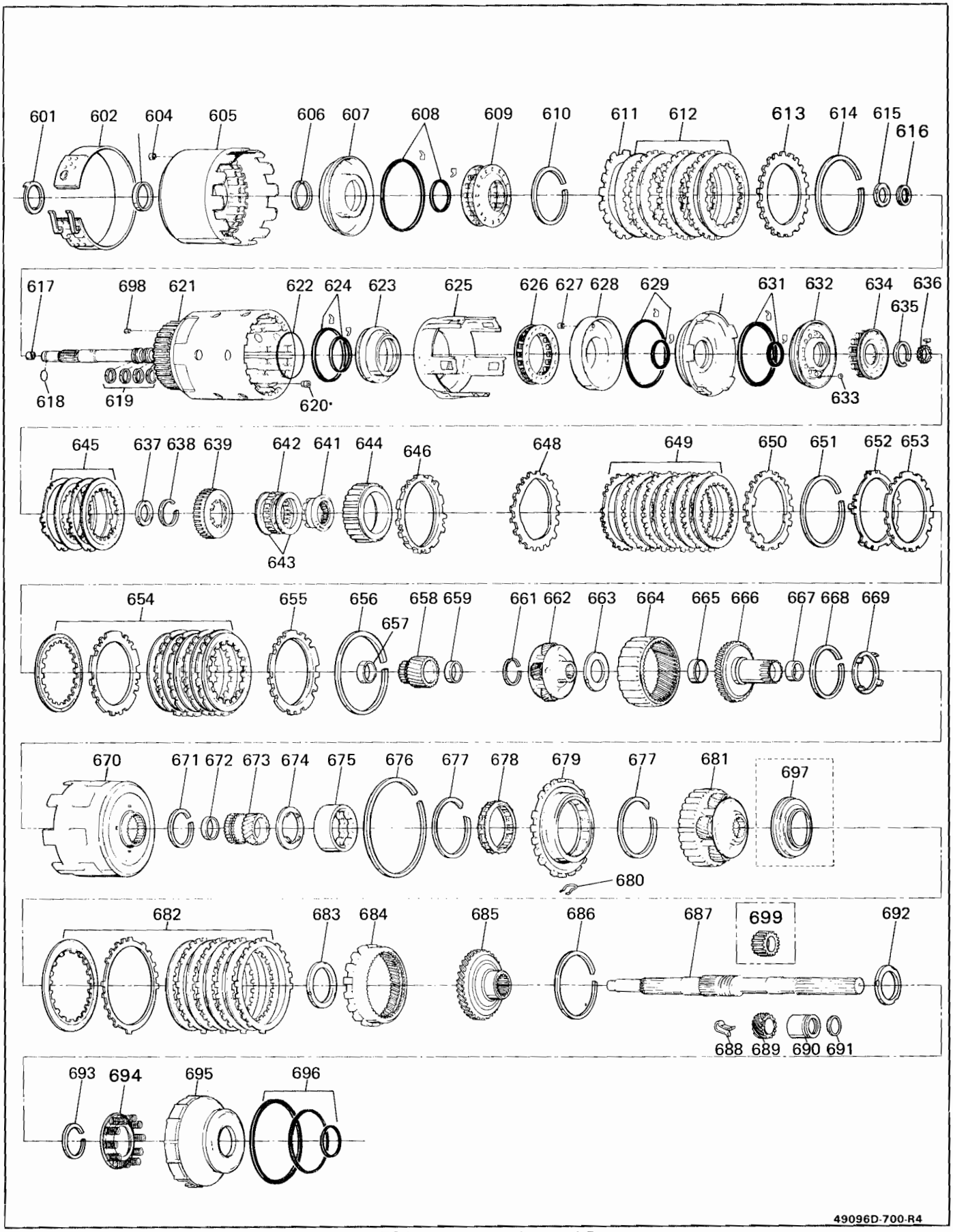


Figure 58 Transmission Internal Parts

ILL. NO.	DESCRIPTION
601	WASHER, THRUST (PUMP TO DRUM)
602	BAND ASSEMBLY, 2-4
603	BUSHING, REVERSE INPUT CL. (FRONT)
604	RETAINER & BALL ASM., CHECK VALVE
605	HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
606	BUSHING, REVERSE INPUT CLUTCH (REAR)
607	PISTON ASM., REVERSE INPUT CLUTCH
608	SEALS, REVERSE INPUT CLUTCH (INNER & OUTER)
609	SPRING ASM., REVERSE INPUT CLUTCH
610	RING, REVERSE INPUT CLUTCH SPRING RETAINER
611	PLATE, REVERSE INPUT CLUTCH (WAVED)
612	PLATE ASM., REVERSE INPUT CLUTCH
613	PLATE, REVERSE INPUT CLUTCH BACKING
614	RING, REVERSE INPUT CL. RETAINING
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
617	RETAINER & BALL ASM., CHECK VALVE
618	SEAL, "O" RING (TURBINE SHAFT/ SELECTIVE WASHER)
619	RING, OIL SEAL (SOLID)
620	RETAINER & CHECK BALL ASSEMBLY
621	HOUSING & SHAFT ASSEMBLY, INPUT
622	SEAL, "O" RING INPUT TO FORWARD HSG.
623	PISTON, 3RD & 4TH CLUTCH
624	SEAL, 3RD & 4TH CL. (INNER & OUTER)
625	RING, 3RD & 4TH CLUTCH APPLY
626	SPRING ASSEMBLY, 3RD & 4TH CLUTCH
627	RETAINER & BALL ASSEMBLY, FORWARD CLUTCH HOUSING
628	HOUSING, FORWARD CLUTCH
629	SEAL, FORWARD CLUTCH (INNER & OUTER)
630	PISTON, FORWARD CLUTCH
631	SEAL, OVERRUN CLUTCH (INNER & OUTER)
632	PISTON, OVERRUN CLUTCH
633	BALL, OVERRUN CLUTCH
634	SPRING ASSEMBLY, OVERRUN CLUTCH
635	SNAP RING, OVERRUN CLUTCH SPRING RETAINER
636	SEAL, INPUT HOUSING TO OUTPUT SHAFT
637	BEARING ASSEMBLY, INPUT SUN GEAR
638	SNAP RING, OVERRUN CL. HUB RETAINING
639	HUB, OVERRUN CLUTCH
641	RETAINER & RACE ASSEMBLY, SPRAG
642	FORWARD SPRAG ASSEMBLY
643	RETAINER RINGS, SPRAG ASSEMBLY
644	RACE, FORWARD CLUTCH (OUTER)
645	PLATE ASSEMBLY, OVERRUN CLUTCH
646	PLATE, FORWARD CLUTCH APPLY
648	PLATE, FORWARD CLUTCH (WAVED)
649	PLATE ASSEMBLY, FORWARD CLUTCH
650	PLATE, FORWARD CLUTCH BACKING (SEL.)
651	RING, FORWARD CLUTCH BACKING PLATE RETAINER
652	PLATE, 3RD & 4TH CLUTCH RING RETAINER
653	PLATE, 3RD & 4TH CLUTCH APPLY
654	PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655	PLATE, 3RD & 4TH CLUTCH BACKING (SEL.)
656	RING, 3RD & 4TH CLUTCH BACKING PLATE RETAINER
657	BUSHING, INPUT SUN GEAR (FRONT)
658	GEAR, INPUT SUN
659	BUSHING, INPUT SUN GEAR (REAR)
661	RET., OUTPUT SHAFT TO INPUT CARRIER
662	CARRIER ASSEMBLY, INPUT (COMPLETE)
663	BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)
664	GEAR, INPUT INTERNAL
665	BUSHING, REACTION CARRIER SHAFT (FRONT)
666	SHAFT, REACTION CARRIER
667	BUSHING, REACTION CARRIER SHAFT (REAR)
668	RING, REACTION SHAFT/INTERNAL GEAR RETAINER
669	WASHER, THRUST (REACTION SHAFT/ SHELL)
670	SHELL, REACTION SUN
671	RING, REACTION SUN GEAR RETAINER
672	BUSHING, REACTION SUN
673	GEAR, REACTION SUN
674	WASHER, THRUST (RACE/REACTION SHELL)
675	RACE, LO & REVERSE ROLLER CLUTCH
676	RING, LO & REVERSE SUPPORT TO CASE RETAINER
677	RING, LO & REVERSE RETAINER (ROLLER ASSEMBLY/CAM)
678	CLUTCH ASSEMBLY, LO & REVERSE ROLLER
679	SUPPORT ASM., LO & REVERSE CLUTCH
680	SPRING, TRANSMISSION (LO & REVERSE CLUTCH SUPPORT RETAINER)
681	CARRIER ASSEMBLY, REACTION
682	PLATE ASSEMBLY, LO & REVERSE CLUTCH
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
684	GEAR, INTERNAL REACTION
685	SUPPORT, INTERNAL REACTION GEAR
686	RING, REACTION GEAR/SUPPORT RETAINER
687	SHAFT, OUTPUT
688	CLIP, SPEEDO DRIVE GEAR
689	GEAR, SPEEDO DRIVE
690	SLEEVE, OUTPUT SHAFT
691	SEAL, OUTPUT SHAFT
692	BRG., REACTION GEAR SUPPORT TO CASE
693	RING, LO & REVERSE CLUTCH RETAINER
694	SPRING ASSEMBLY, LO & REVERSE CLUTCH
695	PISTON, LO & REVERSE CLUTCH
696	SEAL, TRANSMISSION (LO & REVERSE CLUTCH — OUTER, CENTER, INNER)
697	DEFLECTOR, OIL (HIGH OUTPUT MODELS ONLY)
698	PLUG, ORIFICED CUP
699	ROTOR, INTERNAL TRANSMISSION SPEED SENSOR

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Figure 58L

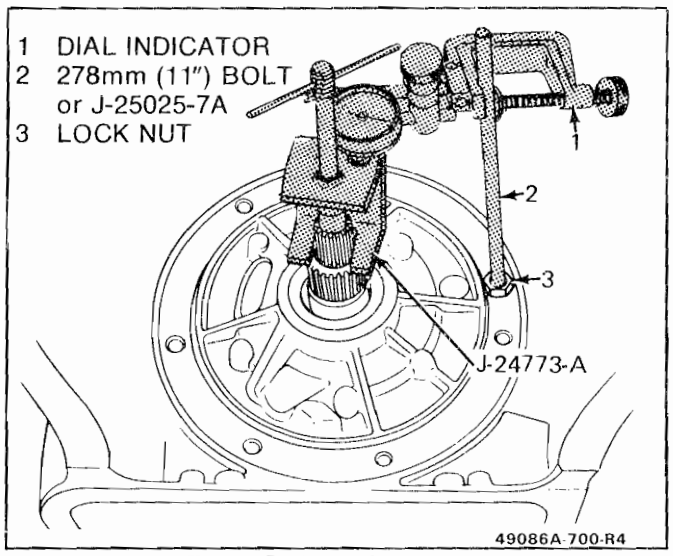


Figure 57 End Play Check

1. Input carrier to output shaft retaining ring (661) with J-34627. Do not overexpand the ring.
2. Input carrier assembly (662)
3. J-29837 and output shaft (687)

Important

- The manufacturer assembles the output shaft and reaction internal gear with adhesive for ease of assembly. If these parts have not become separated during use, the output shaft will come out later along with the reaction internal gear.

4. Thrust bearing assembly (663)

Reaction Gear Set

Remove or Disconnect (Figures 58, 58L, 63)

1. Input internal gear (664) and reaction carrier (666)
2. Reaction sun shell (670) and thrust washer (669)
3. Reaction sun shell to inner race thrust washer (674)
4. Lo and reverse support to case retainer ring (676)
5. Lo and reverse clutch support retainer spring (680)
6. Reaction sun gear (673)
7. Lo and reverse inner race (675), roller assembly (678), support assembly (679), and reaction carrier assembly (681)
8. Lo and reverse clutch plates (682)
9. Reaction internal gear (684) and thrust bearing assembly (683)
10. Reaction gear support to case bearing (692)

Lo and Reverse Clutch Parts

Remove or Disconnect (Figures 63, 64 and 65)

TOOLS REQUIRED:
J-23327 Clutch Spring Compressor

1. Bolts (715) and parking lock bracket (710)

Important

- Due to interference, the parking pawl may have to be removed before removing or installing the low and reverse piston.

2. Parking pawl shaft plug (713) with a #4 screw extractor
3. Parking pawl pivot shaft (712) with a magnet
4. Parking pawl (711) and return spring (714)
5. Install tool J-23327.
6. Lo and reverse clutch retainer ring (693)
7. Lo and reverse clutch spring assembly (694)
8. Lo and reverse clutch piston (695)
   - by application of air pressure in the case apply passage

COMPONENT REPAIR AND TRANSMISSION REASSEMBLY

Inner Manual Linkage

Remove or Disconnect (Figure 65)

1. Inside manual shaft nut (702)
2. Manual shaft (707) and manual shaft retainer (706)
3. Parking lock actuator assembly (701) and inside detent lever (703)

Manual Shaft Seal Replacement

Remove or Disconnect (Figure 66)

- Manual shaft seal (708)
  - pry out with a screwdriver

Install or Connect

- Tap a new seal in place
  - use a 14 mm socket

Inspect (Figures 65 and 66)

- Actuator rod (701) for damage
- Inside detent lever (703) for damage or cracks
- Manual shaft (707) for damage or burrs
- Manual detent spring assemby (709) for roller freeness or damage

Install or Connect (Figure 53)

- Parking lock actuator (701) onto inside detent lever (703)
- Manual shaft (707) into case (10) and inside detent lever (703)
- Inside manual shaft nut (702) onto manual shaft (707)
  - torque to 31 N·m (23 ft. lbs.)
- Manual shaft retainer (706) onto manual shaft (707)

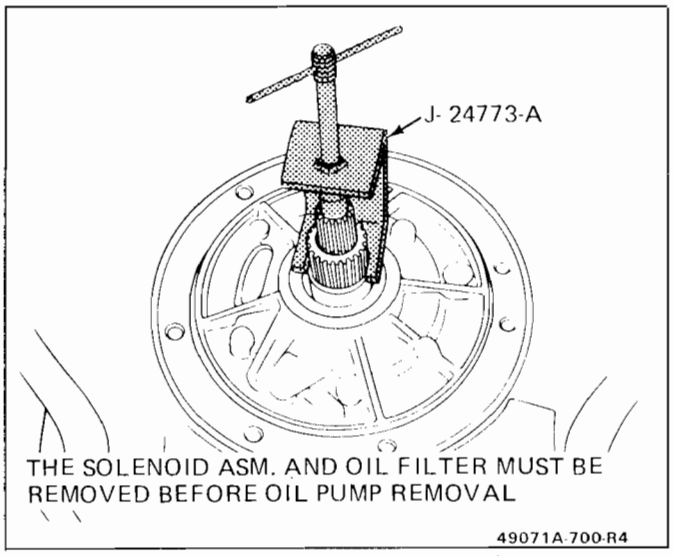
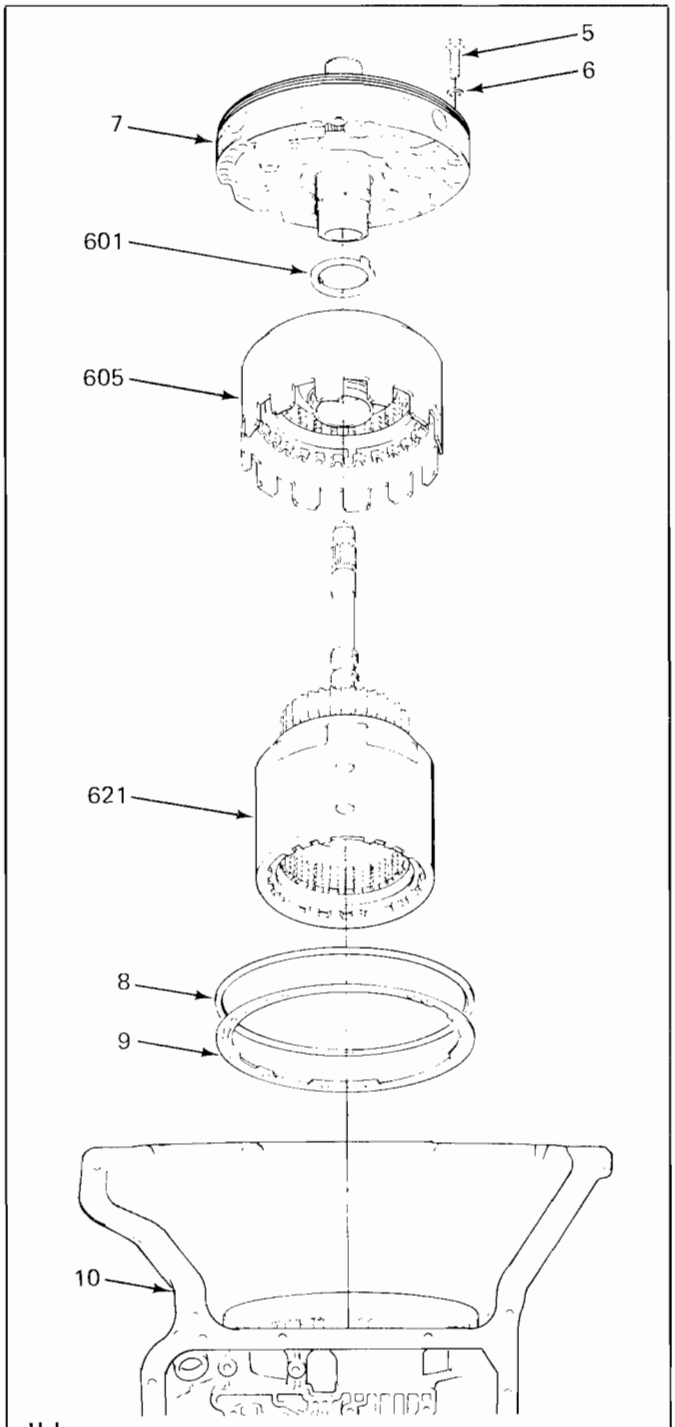


Figure 59 Oil Pump Removal

Case

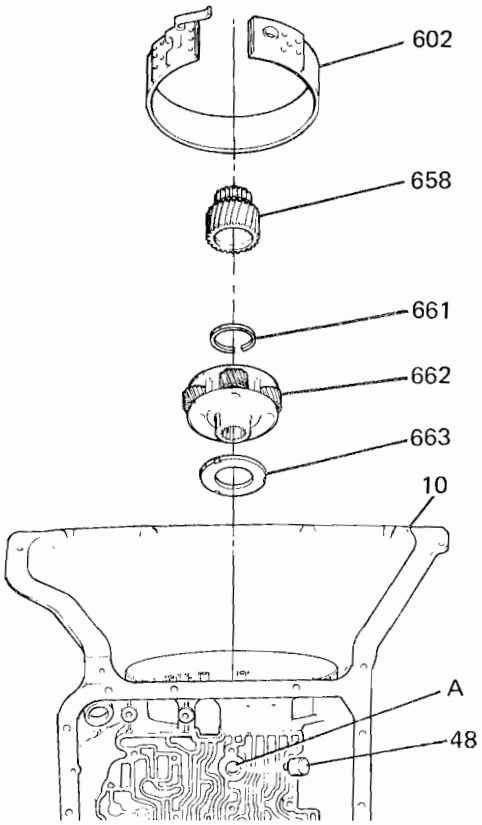
Inspect (Figures 67, 68 and 69)

- Case (10) exterior for cracks or porosity
- Case to valve body face for damage, interconnected oil passages and flatness
  - the face flatness can be checked by inspecting the spacer plate to case gasket for proper land impressions.
- Vent assembly (11) for damage
- Air check all oil passages.
  - see diagnosis section for oil passage identification.
- 2-4 servo bore for
  - damage, porosity, or burrs
  - any sharp edges (i.e. - oil passages, slots for retaining ring removal - remove if found)
- Orifice cup plug (86) in servo bore for debris or damage
- Third accumulator bore for
  - porosity, damage, or burrs
  - pin damage (77)
  - orifice cup plug (81) damaged or plugged
- Speedometer bore
  - damaged
  - sharp edges
  - porosity
- All bolt holes for thread damage
  - Heli-coil to repair
- Cooler connectors (12) for
  - damage
  - proper torque 38 N·m (28 ft. lbs.)
- Case interior for
  - damaged ring grooves or casting flash
  - clutch plate lugs worn or damaged
  - bushing (76) scored, worn, or damaged (see Bushing Replacement)
  - governor support pin installation depth. (Incorrect installation depth will cause governor driven gear damage and shift problems.)



ILL. NO.	DESCRIPTION
5	BOLT, PUMP TO CASE
6	WASHER, PUMP TO CASE BOLT
7	PUMP ASSEMBLY, OIL
8	SEAL, OIL (PUMP TO CASE)
9	GASKET, PUMP COVER TO CASE
10	CASE, TRANSMISSION
601	WASHER, THRUST (PUMP TO DRUM)
605	HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
621	HOUSING & SHAFT ASSEMBLY, INPUT

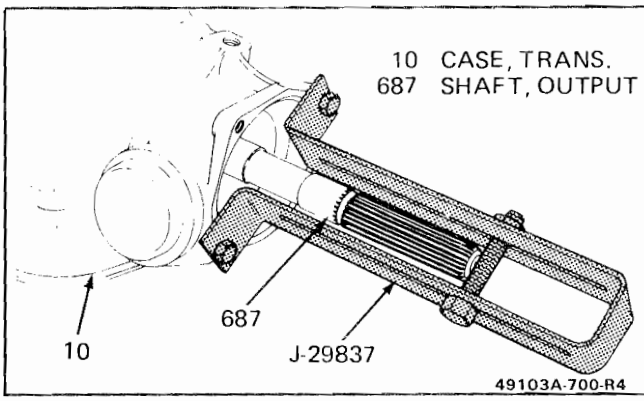
Figure 60 Input Clutch Removal



A BAND ANCHOR PIN LOCATION
10 CASE, TRANSMISSION
48 PIN, BAND ANCHOR
602 BAND ASSEMBLY, 2-4
658 GEAR, INPUT SUN
661 RET., OUTPUT SHAFT TO INPUT CARRIER
662 CARRIER ASSEMBLY, INPUT – COMPLETE
663 BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)

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Figure 61 Input Carrier Removal



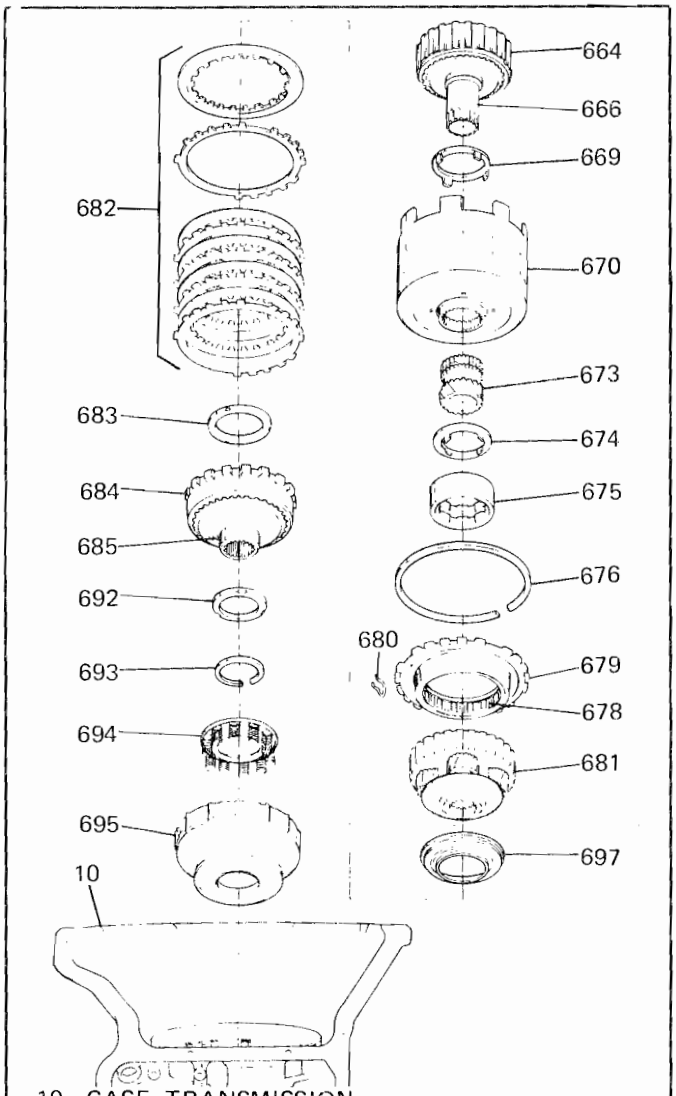
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Figure 62 Output Shaft Support Fixture

Third Accumulator Retainer and Ball Assembly (80)

Inspect

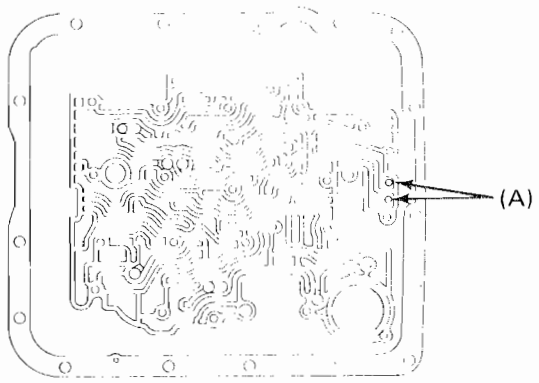
- Ball
  - missing



10 CASE, TRANSMISSION
664 GEAR, INPUT INTERNAL
666 SHAFT, REACTION CARRIER
669 WASHER, THRUST (REACTION SHAFT/SHELL)
670 SHELL, REACTION SUN
673 GEAR, REACTION SUN
674 WASHER, THRUST (RACE/REACTION SHELL)
675 RACE, LO & REVERSE ROLLER CLUTCH
676 RING, LO & REVERSE SUPPORT TO CASE RETAINER
678 CLUTCH ASSEMBLY, LO & REVERSE ROLLER
679 SUPPORT ASSEMBLY, LO & REVERSE CLUTCH
680 SPRING, TRANSMISSION LO & REVERSE CLUTCH SUPPORT RETAINER
681 CARRIER ASSEMBLY, REACTION
682 PLATE ASSEMBLY, LO & REVERSE CLUTCH
683 BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
684 GEAR, INTERNAL REACTION
685 SUPPORT, INTERNAL REACTION GEAR
692 BRG., REACTION GEAR SUPPORT TO CASE
693 RING, LO & REVERSE CLUTCH RETAINER
694 SPRING ASSEMBLY, LO & REVERSE CLUTCH
695 PISTON, LO & REVERSE CLUTCH
697 DEFLECTOR, OIL (HIGH OUTPUT MODELS ONLY)

49222A-700-R4

Figure 63 Reaction Gear Set Removal



(A) APPLY AIR PRESSURE HERE TO REMOVE LO & REVERSE PISTON FROM THE CASE

49244A-700-R4

Figure 64 Piston Removal

- sticking or leaking
- Retainer
  - missing
  - loose
  - not seated correctly
  - feed slots restricted

Retainer and Ball Assembly Leak Check Procedure

Important (Figure 70)

1. Install the servo assembly into the servo bore.
2. Install the servo cover and retainer.
3. Pour a suitable solvent into the accumulator bore.
4. Watch for leakage inside the case.
5. If leakage is observed, replace the third accumulator retainer and ball assembly.

Replacement Procedure - Third Accumulator Retainer and Ball Assembly

Remove or Disconnect (Figure 70 and 71)

TOOLS REQUIRED:

6.3 mm (#4) Screw Extractor

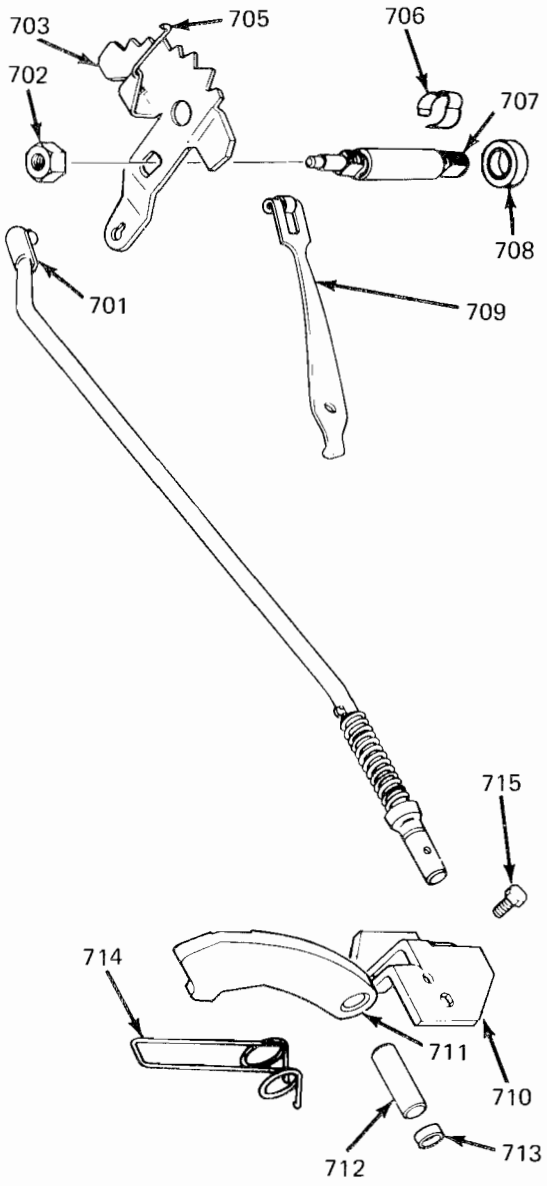
- Third accumulator retainer and ball assembly (80)
  - use 6.3 (#4) screw extractor

Install or Connect (Figure 70 and 71)

TOOLS REQUIRED:

9.5 mm (3/8 in.) Diameter Metal Rod

- A new third accumulator retainer and ball assembly
  - oil feed slots in the retainer must line up with oil passage in the servo bore. To be certain of correct installation depth, scribe a mark at 42.0 mm (1. 653 in.) on the 9.5 mm (3/8″)



ILL. NO.	DESCRIPTION
701	ACTUATOR ASSEMBLY, PARKING LOCK
702	NUT, HEX HEAD
703	LEVER, INSIDE DETENT
705	LINK, MANUAL VALVE
706	RETAINER, MANUAL SHAFT
707	SHAFT, MANUAL
708	SEAL, MANUAL SHAFT
709	MANUAL DETENT ROLLER AND SPRING ASM.
710	BRACKET, PARKING LOCK
711	PAWL, PARKING BRAKE
712	SHAFT, PARKING BRAKE PAWL
713	PLUG, STEEL CUP
714	SPRING, PARKING PAWL RETURN
715	BOLT, PARKING LOCK BRACKET

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Figure 65 Parking Linkage

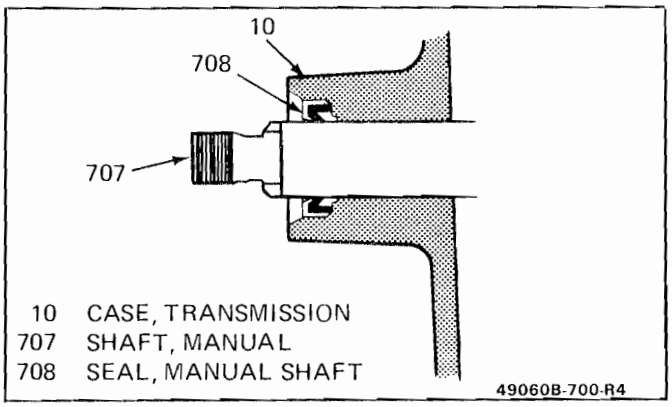


Figure 66 Manual Shaft Seal

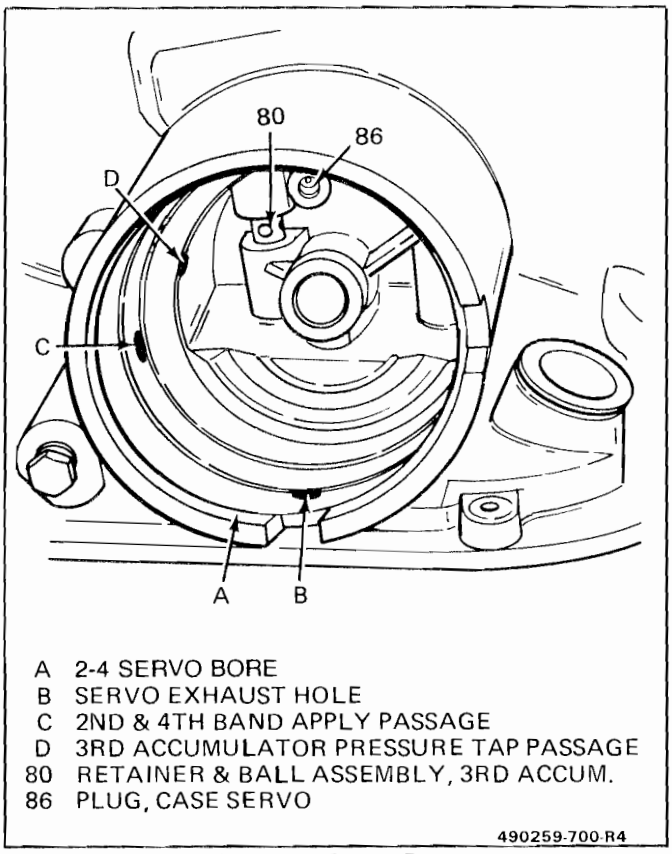


Figure 67 Servo Bore

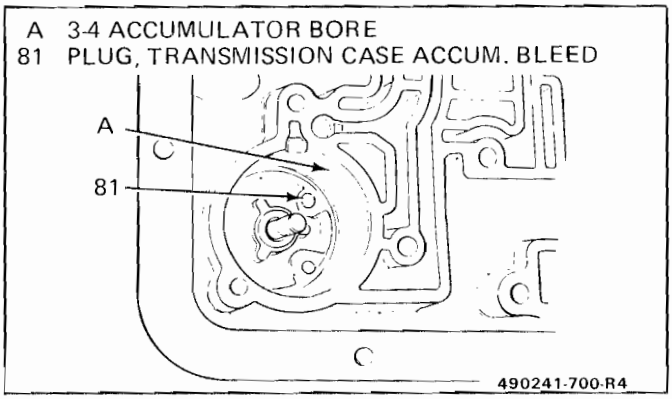


Figure 68 Third Accumulator Bore

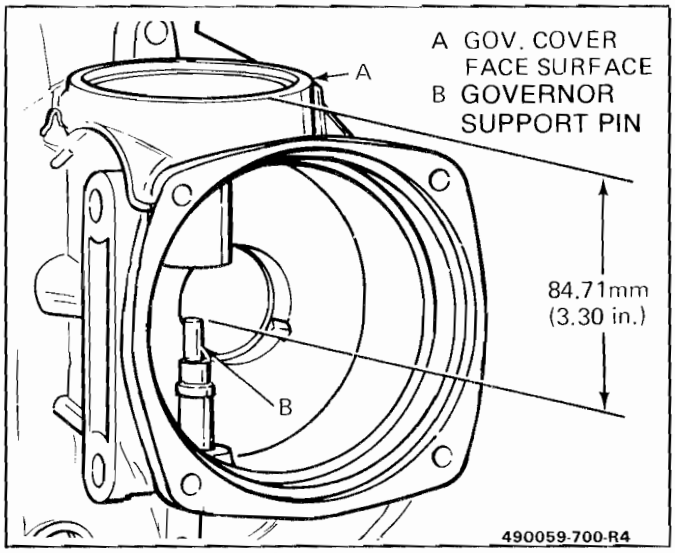


Figure 69 Governor Pin Location

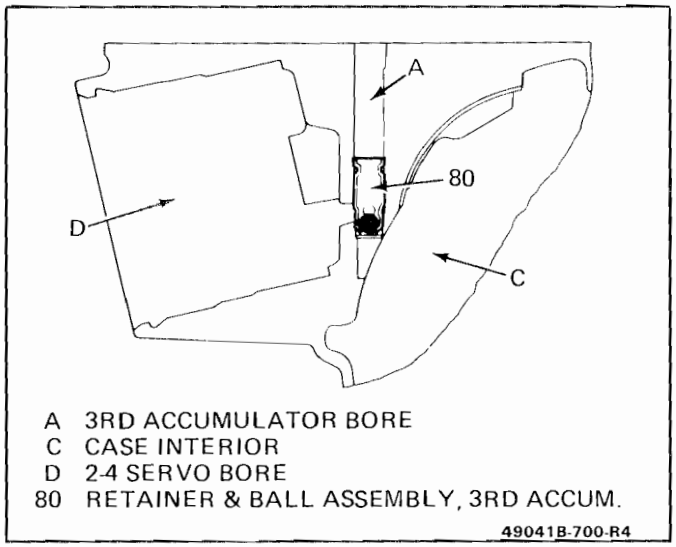


Figure 70 Leak Check - 3rd Accumulator

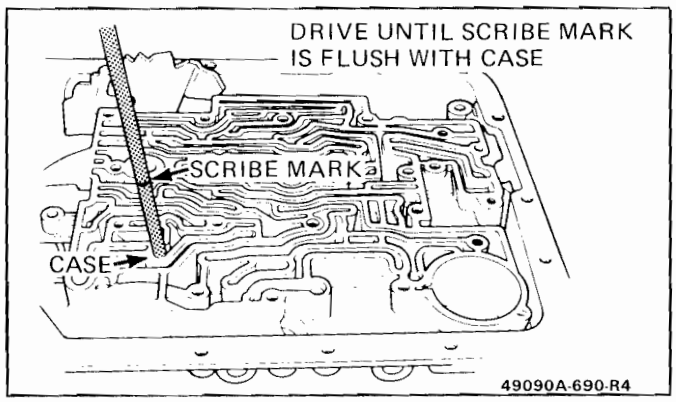


Figure 71 Third Accumulator Retainer and Ball Asm. - Installation

diameter metal rod. Use it to seat the third accumulator and ball assembly as shown. When the scribed line is flush with the case face, installation depth is correct.

Case Assembly

Clean

- Thoroughly with solvent
- Air dry
  - do not wipe with cloth.

Lo and Reverse Clutch Assembly

Inspect (Figure 73)

- Lo and reverse piston (695) for
  - porosity or damage
  - ring groove damage
- Piston seals (696) for nicks or cuts
- Spring assembly (694) for damage
- Retainer ring (693) overstressed

Measure (Figure 72)

TOOLS REQUIRED:
Scale and Straight Edge

- Dimension "A" for correct piston/model application

Install or Connect (Figure 73)

TOOLS REQUIRED:
J-23327 Clutch Spring Compressor

1. Piston seals (696) onto the piston (695)
   - lubricate with transmission fluid
2. Piston (695) into the case
   - index the piston with the notch in the bottom of the case.
3. Spring assembly (694) onto the piston
   - flat side of the retainer upward
4. J-23327 over the spring assembly
   - compress the spring assembly past the ring groove in the case hub.
5. Retainer ring (693) into the case hub ring groove

Parking Pawl

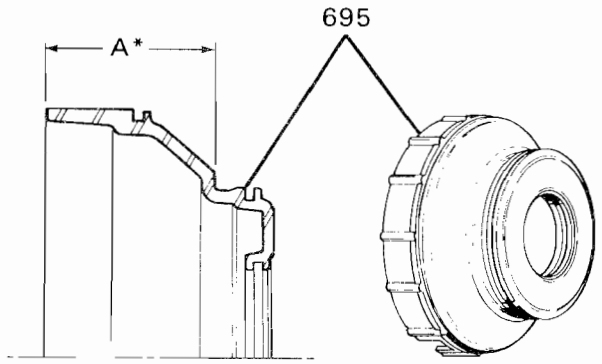
Inspect (Figure 74)

- Parking pawl (711) for cracks, burrs, or damage
- Parking pawl return spring (714) for distortion or damage
- Parking pawl pivot shaft (712) for damage and freeness of fit with the parking pawl

Install or Connect (Figure 74)

1. Parking pawl (711) and parking pawl return spring (714) into the case
2. Parking pawl pivot shaft (712) into the parking pawl (711) and the case
   - **CHECK FOR PROPER OPERATION**
3. Retaining plug (713) into the case
   - coat the plug with loc-tite sealant or equivalent and install it with a hammer and punch.

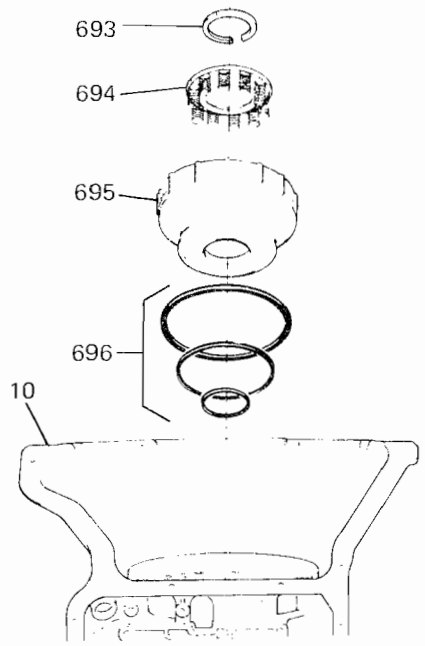
LO & REVERSE CLUTCH PISTON	
MODEL	**PISTON DIMENSION *A**
MCM, MTM, PRM, TAM, TBM, YXM	60.92 mm (2.398")
ALL OTHERS	56.52 mm (2.225")



695 PISTON, LO & REVERSE CLUTCH

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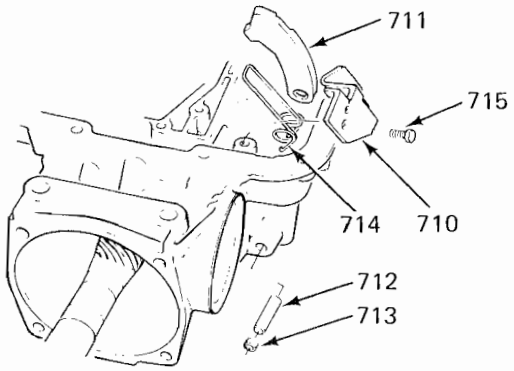
Figure 72 Lo and Reverse Clutch Piston Measurement



10 CASE, TRANSMISSION
693 RING, LO & REVERSE CLUTCH RETAINER
694 SPRING ASSEMBLY, LO & REVERSE CLUTCH
695 PISTON, LO & REVERSE CLUTCH
696 SEALS, LO & REVERSE CLUTCH

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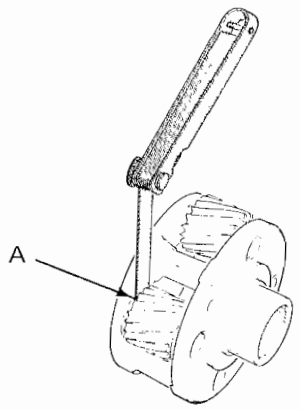
Figure 73 Lo and Reverse Piston



710 BRACKET, PARKING LOCK
711 PAWL, PARKING BRAKE
712 SHAFT, PARKING BRAKE PAWL
713 PLUG, STEEL CUP
714 SPRING, PARKING PAWL RETURN
715 BOLT, PARKING LOCK BRACKET

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Figure 74 Parking Pawl Installation



A PINION GEAR END PLAY – .20/.60 MM (.008/.024 IN.)

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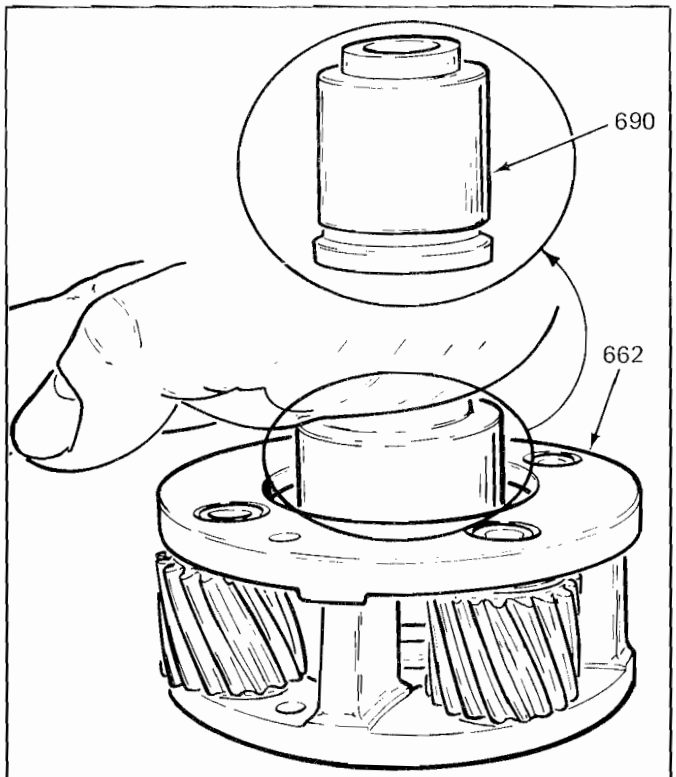
Figure 75 Pinion End Play Check

Reaction Internal Gear and Carrier Assembly

Inspect (Figures 75, 76 and 77)

- Reaction internal gear (683) and support (684) for
  - proper assembly
  - stripped splines
  - cracks
  - teeth or lug damage
- Thrust bearing assemblies (683 and 692) for damage
- Lo and reverse clutch plates (682)
  - Composition for wear, heat damage, or delamination
  - Steel for heat damage or surface finish damage
- Reaction carrier assembly (681) for
  - pinion gear damage
  - excessive pinion washer wear (end play .20-.61 mm/.008-.024 in.)
  - proper pinion staking
  - keystoned pinion gears (pinions must turn free)
  - damaged or worn thrust bearing

  To check the captive thrust bearing in the carrier for wear, place a bushing or an output shaft sleeve on the bearing race (do not contact the pinion gears) and turn it with the palm of your hand. Any imperfections will be felt through the bushing.



662 CARRIER ASSEMBLY, INPUT – COMPLETE
690 SLEEVE, OUTPUT SHAFT

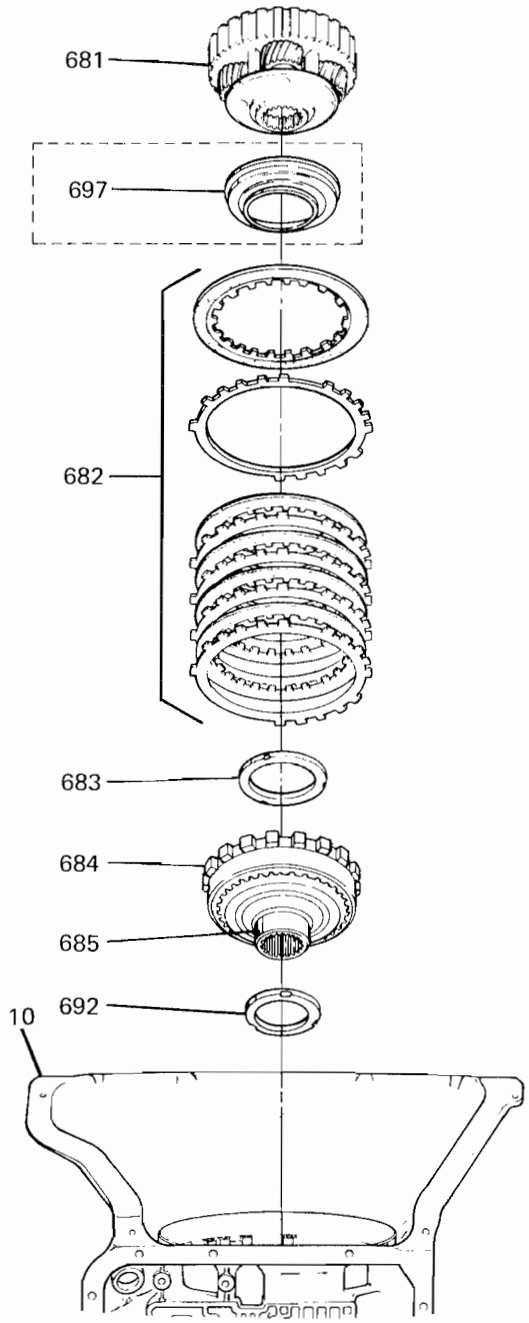
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Figure 76 Captured Bearing Check

Reaction Internal Gear and Support

Install or Connect (Figures 78, 79 and 80)

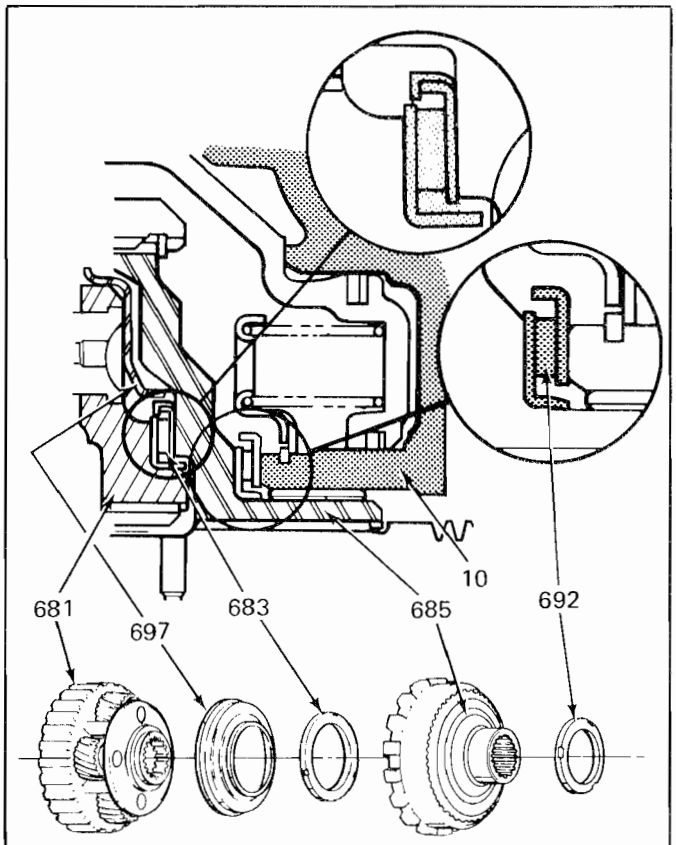
1. Reaction gear support to case bearing (692) onto the case hub as shown
   - Outside bearing race goes toward case hub.
   - retain with petrolatum.
2. Reaction internal gear and support (684 and 685) onto the bearing as shown
3. Reaction carrier to support thrust bearing assembly (683) onto the support (685)
   - outer bearing race goes toward the support
4. Reaction carrier (681) onto the thrust bearing
5. Lo and reverse clutch plates (682) into case lugs
   - start with a steel plate and alternate with composition.
   - index with the splines of the reaction carrier and the case as shown.
   - see the chart for the correct number of clutch plates.



ILL. NO.	DESCRIPTION
10	CASE, TRANSMISSION
681	CARRIER ASSEMBLY, REACTION
682	PLATE ASSEMBLY, LO & REVERSE CLUTCH
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
684	GEAR, INTERNAL REACTION
685	SUPPORT, INTERNAL REACTION GEAR
692	BRG., REACTION GEAR SUPPORT TO CASE
697	DEFLECTOR, OIL (HIGH OUTPUT MODELS ONLY)

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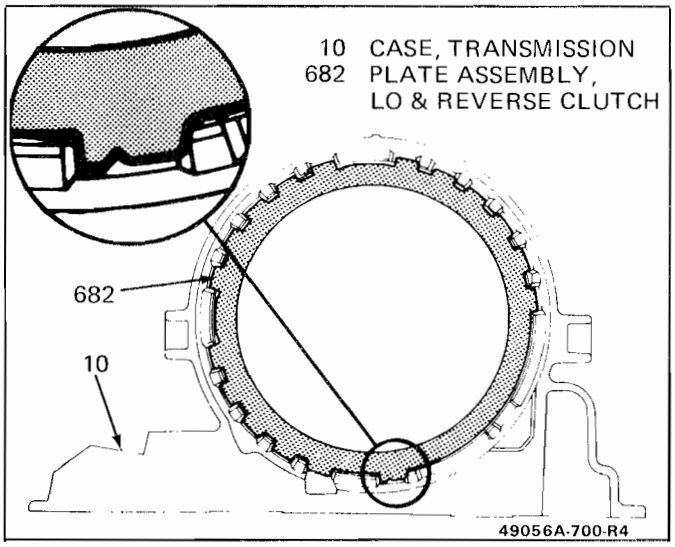
Figure 77 Reaction Internal Gear and Carrier Assembly Installation



ILL. NO.	DESCRIPTION
10	CASE, TRANSMISSION
681	CARRIER ASSEMBLY, REACTION
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
685	SUPPORT, INTERNAL REACTION GEAR
692	BRG., REACTION GEAR SUPPORT TO CASE
697	DEFLECTOR, OIL (HIGH OUTPUT MODELS ONLY)

49007B-700-R4

Figure 78 Reaction Internal Gear and Carrier Bearing Locations



49056A-700-R4

Figure 79 Lo and Reverse Clutch Plates Properly Installed

LO & REVERSE CLUTCH				
MODEL	FLAT STEEL		COMP. FACED	
	No.	Thick-ness	No.	Thick-ness
MCM, MTM, PRM, TAM, TBM, YXM	4	1.77mm (.069")	4	2.25mm (.088")
ALL OTHERS	5	1.77mm (.069")	5	2.25mm (.088")

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Figure 80 Lo and Reverse Clutch Plate Chart

Lo and Reverse Support Assembly

Remove or Disconnect (Figure 81)

1. Inner race (675) from the support assembly
2. One retainer ring (677)
3. Roller clutch assembly (678)

Inspect (Figure 81)

- Inner race (675) for damage and surface finish
- Roller clutch assembly (678) for
  - damaged rollers
  - broken springs
- Cam and support assembly for
  - loose cam
  - surface finish
  - cracks or damaged lugs.

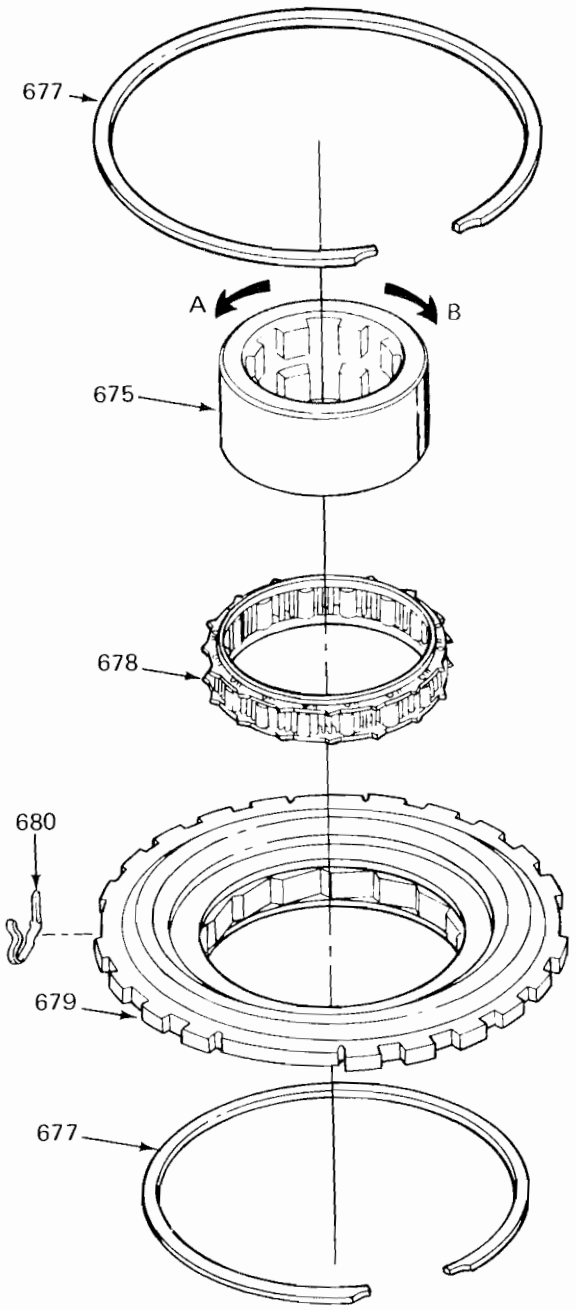
Install or Connect (Figure 81 and 82)

1. Roller clutch assembly (678) into the cam and support assembly (679)
2. Support and roller assembly into the case with the hub down
3. Inner race (675) into the roller assembly
   - rotate as shown in figure 65.
   - push down for full engagement.
   - bottom tangs will be flush with carrier hub when properly installed.
4. Support retainer spring (680) into the case
   - insert between the case lug and the one open notch in the support.

Reaction Sun Gear and Shell

Inspect (Figure 84)

- Reaction Sun Gear (673) for
  - nicked, scored, or worn bushing. (See Bushing Replacement).
  - damaged spline or teeth
  - loose or weak retaining ring (do not remove this ring, except to replace it.)
- Reaction sun shell (670) for
  - stripped or worn splines
  - broken hub
  - bent tangs



ILL. NO.	DESCRIPTION
A	LOCKED UP
B	FREE WHEELS
675	RACE, LO & REVERSE ROLLER CLUTCH
677	RING, LO & REVERSE RETAINER (ROLLER ASSEMBLY/CAM)
678	CLUTCH ASSEMBLY, LO & REVERSE ROLLER
679	SUPPORT ASSEMBLY, LO & REVERSE CLUTCH
680	SPRING, TRANSMISSION LO & REVERSE CLUTCH SUPPORT RETAINER

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Figure 81 Lo and Reverse Clutch Support Assembly

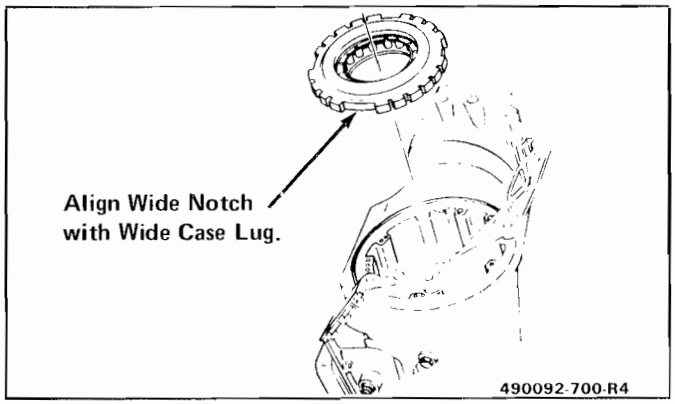
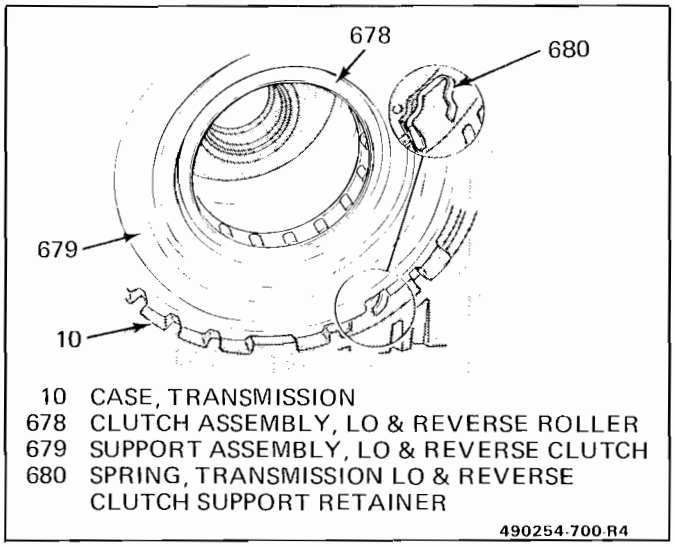


Figure 82 Lo and Reverse Support and Roller Asm. Installation



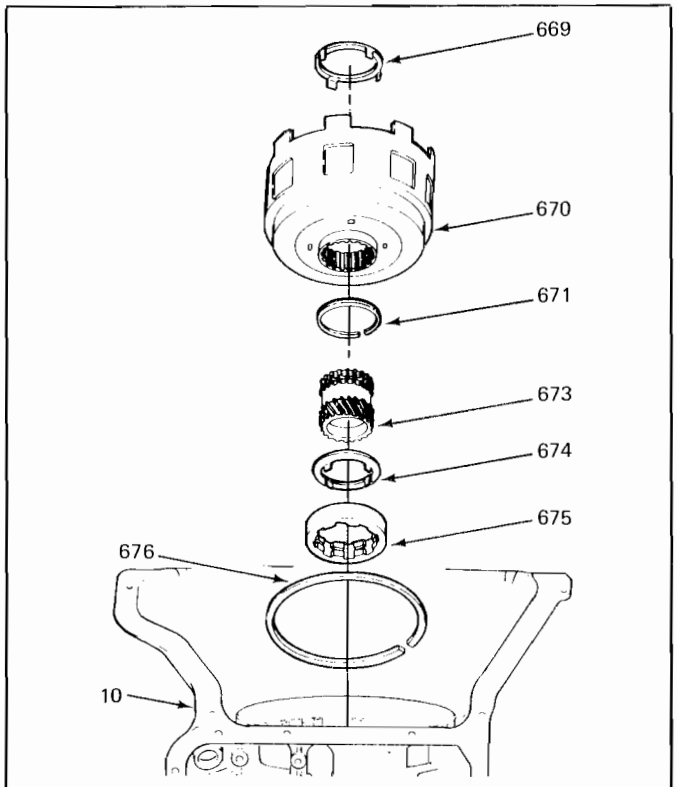
10 CASE, TRANSMISSION
678 CLUTCH ASSEMBLY, LO & REVERSE ROLLER
679 SUPPORT ASSEMBLY, LO & REVERSE CLUTCH
680 SPRING, TRANSMISSION LO & REVERSE CLUTCH SUPPORT RETAINER

Figure 83 Support Spring - Installed

- Lo and reverse inner race to reaction sun gear shell thrust washer (674) for wear or damage
- Reaction shaft to reaction sun gear shell thrust washer (669) for wear or damage (bronze thrust washer).

Install or Connect (Figure 84 and 85)

1. Reaction sun gear retainer ring (671) onto the reaction sun gear, if previously removed.
2. Reaction sun gear (673) into the reaction carrier
   - index the teeth with the pinion gears.
3. Thrust washer (674) onto the lo and reverse support inner race
   - index the four locating ears into the inner race.
4. Reaction gear shell (670) onto the reaction sun gear
5. (Bronze) thrust washer (669) onto the reaction sun shell
   - index tangs into the shell.



10 CASE, TRANSMISSION
669 WASHER, THRUST (REACTION SHAFT/SHELL)
670 SHELL, REACTION SUN
671 RING, REACTION SUN GEAR RETAINER
673 GEAR, REACTION SUN
674 WASHER, THRUST (RACE/REACTION SHELL)
675 RACE, LO & REVERSE ROLLER CLUTCH
676 RING, LO & REVERSE SUPPORT TO CASE RETAINER

Figure 84 Sun Gear and Shell Installation

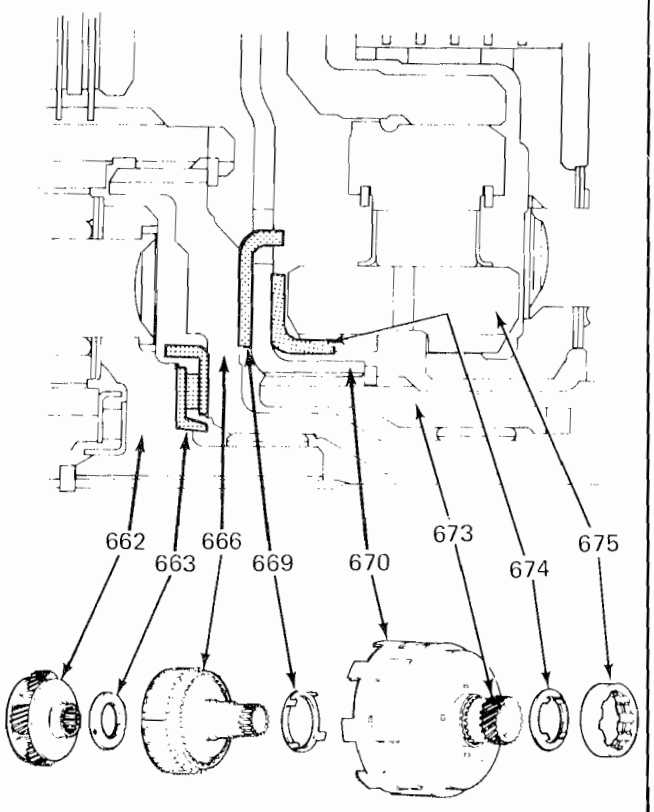
Input Internal Gear and Output Shaft

Remove or Disconnect (Figure 86)

1. Retainer ring (668) from input internal gear (664)
2. Reaction carrier shaft (666) from the input internal gear

Inspect (Figures 86 and 88)

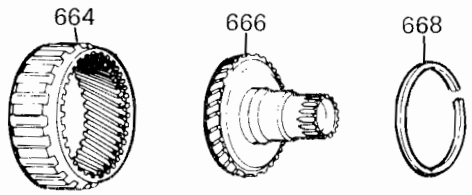
- Reaction Carrier Shaft (666) for
  - scored, damaged, or worn bushings (see Bushing Replacement)
  - cracked shaft
  - damaged spline or gear teeth
  - under cut around the shaft from interference with the sun gear
- Input internal gear (664) for
  - cracks
  - damaged spline or gear teeth
- Input carrier to reaction shaft thrust bearing (663) for wear or damage
- Ouput shaft
  - plugged or restrictred lube passages



662 CARRIER ASSEMBLY, INPUT – COMPLETE
663 BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)
666 SHAFT, REACTION CARRIER
669 WASHER, THRUST (REACTION SHAFT/SHELL)
670 SHELL, REACTION SUN
673 GEAR, REACTION SUN
674 WASHER, THRUST (RACE/REACTION SHELL)
675 RACE, LO & REVERSE ROLLER CLUTCH

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Figure 85 Input Carrier and Reaction Shell Bearing and Thrust Washer Locations



664 GEAR, INPUT INTERNAL
666 SHAFT, REACTION CARRIER
668 RING, REACTION SHAFT/INTERNAL GEAR RETAINER

490225-700-R4

Figure 86 Input Internal Gear and Reaction Shaft

- damaged splines or ring groove
- damaged governor drive gear teeth
- burrs or damage to the front of the shaft at seal area. (Polish with crocus cloth if necessary)
- burrs or damage to bearing journals
- damaged teeth on speed sensor rotor

Internal Transmission Speed Sensor Rotor

REMOVE ONLY IF DAMAGED

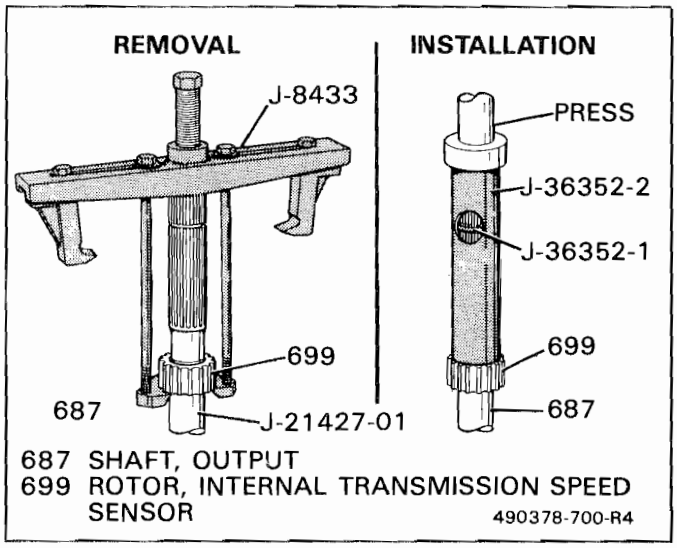
Remove or Disconnect (Figure 87)

TOOLS REQUIRED:
J-21427-01 speedometer gear puller adapter
J-8433 speedometer gear puller
J-36352 speedometer gear installer & "C" washer
Mechanical press

1. Install J-21427 with J-8433 and remove rotor.
2. Place new rotor over output shaft.
3. Place J-36352-1 in groove on output shaft.

– DO NOT REUSE ROTOR

4. Place J-36352-2 on shaft and press to make contact with J-36352-1.



687 SHAFT, OUTPUT
699 ROTOR, INTERNAL TRANSMISSION SPEED SENSOR

490378-700-R4

Figure 87 Internal Transmission Speed Sensor Rotor

Install or Connect (Figures 86 and 88)

1. Reaction shaft (666) into the input internal gear (664)
2. Retainer ring (668) into the input internal gear
3. Input internal gear and shaft assembly into the sun gear shell
   - index the shaft spline into the reaction carrier.
4. Thrust Bearing (663) onto the reaction carrier shaft.
   - outer race goes toward the reaction carrier shaft.
5. Output shaft (687) into the transmission
   - index the splines with the mating parts.
6. J-29837 onto the case
   - position upwards as far as possible to support the output shaft.

Input Carrier and Sun Gear

Inspect (Figures 89 and 90)

- Input carrier assembly (662) for

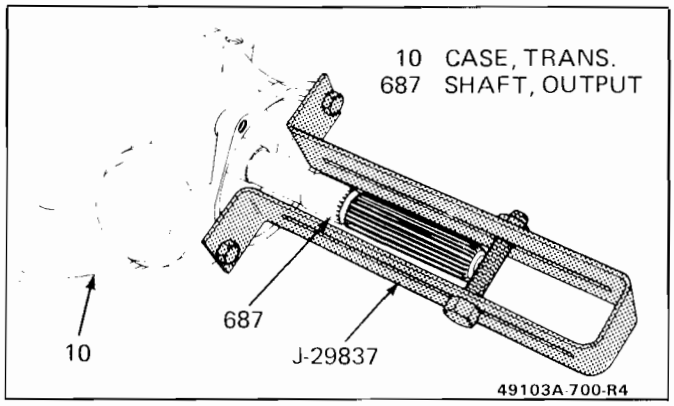


Figure 88 Output Shaft - Installation

- pinion gear damage
- excessive pinion washer wear (end play .20-.61 mm/.008-.024 in.)
- proper pin stake
- keystoned pinion gears (pinion gears must rotate freely)
- damaged or worn thrust bearing

- Input sun gear (658) for
  - bushing damage or wear (see Bushing Replacement Procedure).
  - cracks
  - damaged spline or gear teeth

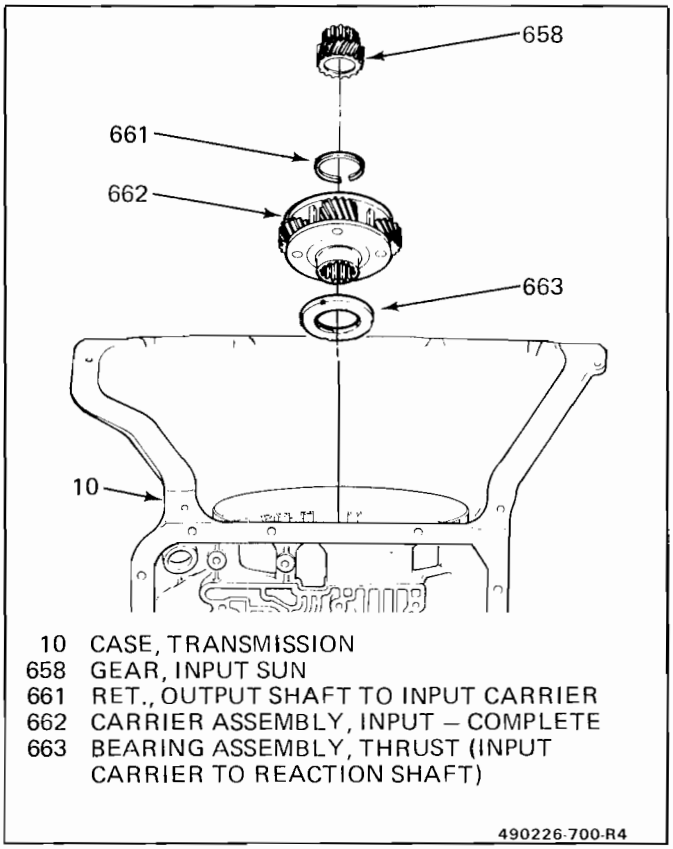


Figure 89 Input Carrier and Sun Gear - Installation

Install or Connect (Figure 89)

TOOLS REQUIRED:

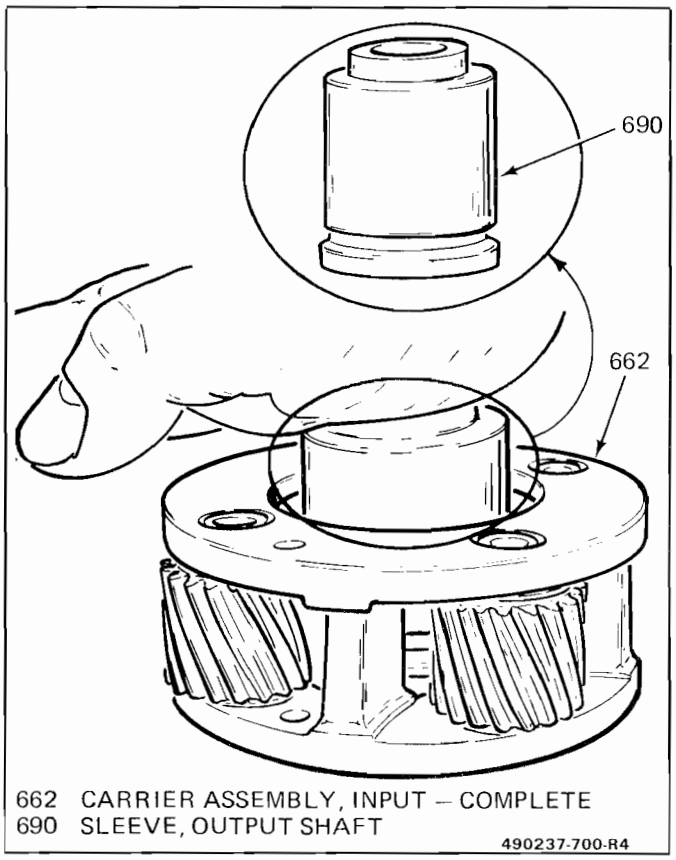


Figure 90 Checking Captured Thrust Bearing

J-34627 Snap Ring Pliers

1. Input carrier assembly (662) onto the output shaft
2. Retainer ring (661) into the output shaft ring groove
   - Do not reuse the old retainer ring if it has been overexpanded.
   - Use care not to overexpand the ring during installation.
3. Remove J-29837.
4. Input sun gear (658) into the input carrier
   - index the sun gear teeth into the pinion gear teeth.
5. Remove J-29837.

Input Clutch Assembly

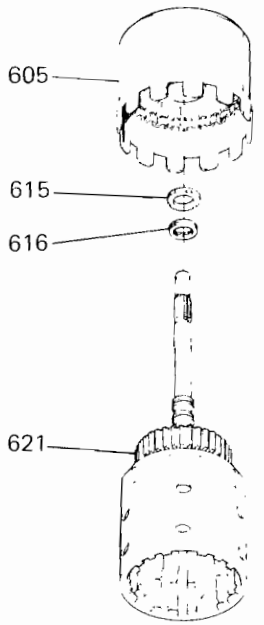
Remove or Disconnect (Figure 91)

- Reverse input clutch assembly (605) from the input clutch assembly (621)
- Oil pump to selective washer thrust bearing (615)
- Selective washer (616)

Disassemble (Figures 93 and 94)

TOOLS REQUIRED:

J-23456 Clutch Spring Compressor Press
J-25018 Clutch Spring Compressor



605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
615 BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
621 HOUSING & SHAFT ASSEMBLY, INPUT

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Figure 91 Reverse Input and Input Clutches

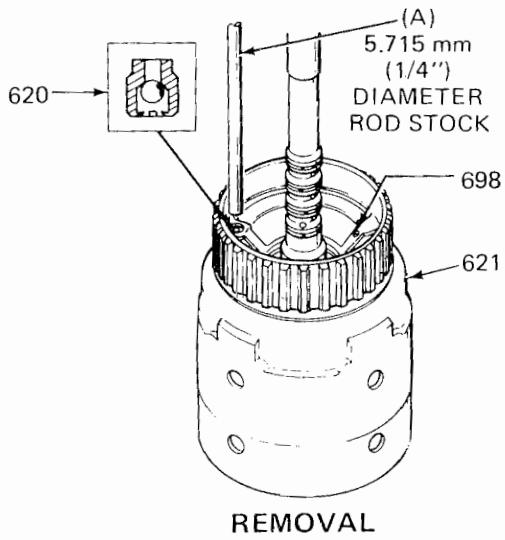
1. Place the input clutch assembly (621) on the bench with the turbine shaft through the bench hole.
2. The 3-4 clutch plate retainer ring (656) and the backing plate (655)
3. The 3-4 clutch plates (654)
4. The 3-4 clutch apply plate (653)
5. The 3-4 clutch ring retainer plate (652)
6. Forward clutch backing plate retainer ring (651) and backing plate (650)
7. Forward clutch sprag assembly (638 - 644)

Disassemble

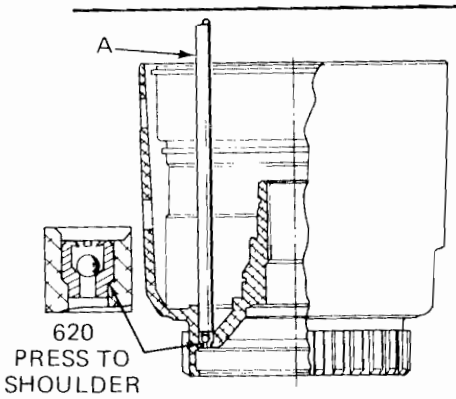
1. Input sun gear bearing assembly (637)
2. Input housing to output shaft lip seal (636).
3. Forward clutch plates (649)
4. Forward wave plate (648)
5. Forward clutch apply plate (646) and spacer plate (647)
6. Overrun clutch plates (645)

Disassemble

1. Install J-23456 and J-25018
   - Compress overrun clutch spring assembly (634).
2. Overrun clutch retainer ring (635).
3. Overrun clutch spring assembly (634).
4. Overrun clutch piston (632)
   - inner and outer lip seals (631)
5. Forward clutch piston assembly (630)



REMOVAL



INSTALLATION

A ROD STOCK/DRIFT, 5.715 mm (1/4") DIA.
620 RETAINER & CHECK BALL ASSEMBLY
621 HOUSING & SHAFT ASSEMBLY, INPUT
698 PLUG, ORIFICED CUP

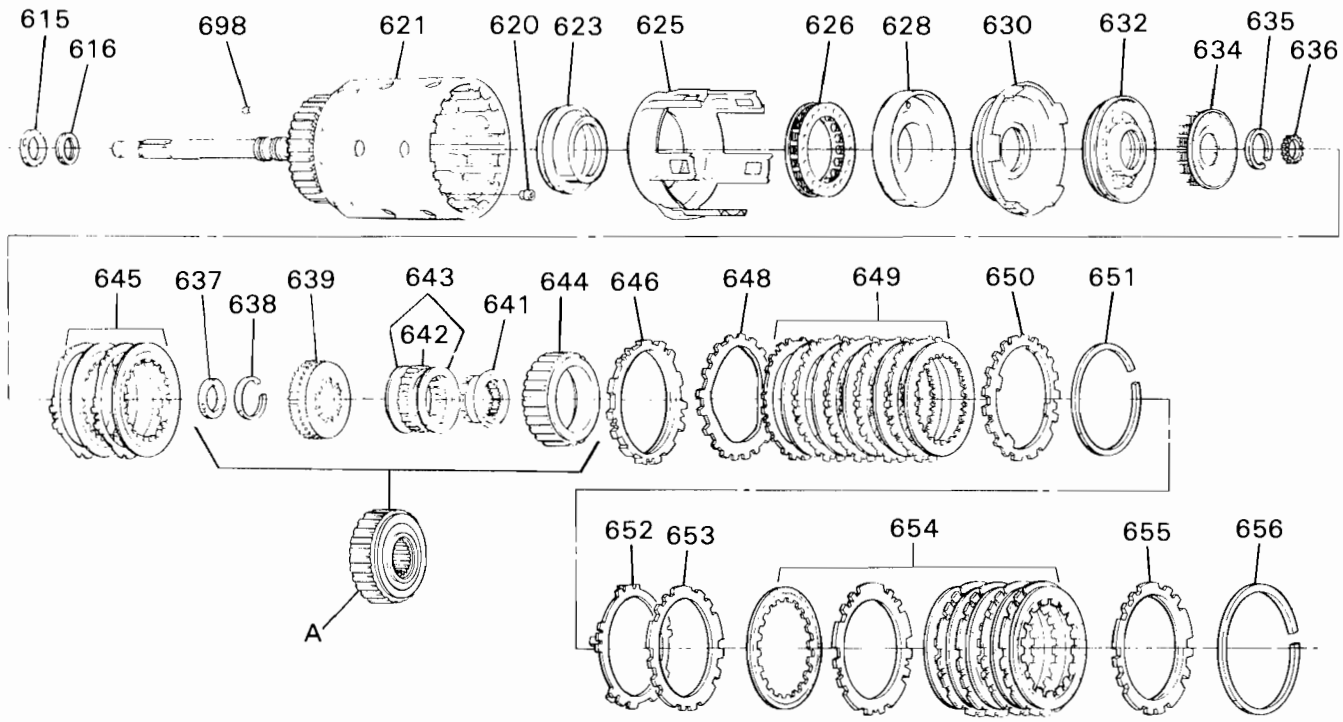
490286-700-R4

Figure 92 Retainer and Check Ball Removal/Installation

   - inner and outer lip seals (629)
6. Forward clutch housing (628)
7. The 3-4 clutch spring assembly (626)
8. The 3-4 clutch apply ring (625) and piston (623)
   - inner and outer lip seals (624) from piston
9. Forward clutch to input housing "O" ring seal (622)
10. Four turbine shaft oil seal rings (619)

Inspect (Figure 97)

1. Input housing for porosity or damage
2. Input housing and shaft assembly (621)
   - all splines for wear or damage
   - air check feed passages.
   - three turbine shaft sealing balls
     - the balls must **not** be loose or leaking.
     - the open hole is the lube oil passage which feeds the output shaft.
   - Presence of orificed cup plug (698)
   - Cracks at lube holes.



ILL. NO.	DESCRIPTION
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
620	RETAINER & CHECK BALL ASSEMBLY
621	HOUSING & SHAFT ASSEMBLY, INPUT
623	PISTON, 3RD & 4TH CLUTCH
625	RING, 3RD & 4TH CLUTCH APPLY
626	SPRING ASSEMBLY, 3RD & 4TH CLUTCH
628	HOUSING, FORWARD CLUTCH
630	PISTON, FORWARD CLUTCH
632	PISTON, OVERRUN CLUTCH
634	SPRING ASSEMBLY, OVERRUN CLUTCH
635	SNAP RING, OVERRUN CLUTCH SPRING RETAINER
636	SEAL, INPUT HOUSING TO OUTPUT SHAFT
645	PLATE ASSEMBLY, OVERRUN CLUTCH
A	FORWARD CLUTCH SPRAG ASSEMBLY
637	BEARING ASSEMBLY, INPUT SUN GEAR
638	SNAP RING, OVERRUN CL. HUB RET.
639	HUB, OVERRUN CLUTCH
641	RETAINER & RACE ASSEMBLY, SPRAG
642	FORWARD SPRAG ASSEMBLY
643	RETAINER RINGS, SPRAG ASSEMBLY
644	RACE, FORWARD CLUTCH (OUTER)
646	PLATE, FORWARD CLUTCH APPLY
648	PLATE, FORWARD CLUTCH (WAVED)
649	PLATE ASSEMBLY, FORWARD CLUTCH
650	PLATE, FORWARD CLUTCH BACKING (SEL.)
651	RING, FORWARD CLUTCH BACKING PLATE RETAINER
652	PLATE, 3RD & 4TH CLUTCH RING RETAINER
653	PLATE, 3RD & 4TH CLUTCH APPLY
654	PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655	PLATE, 3RD & 4TH CLUTCH BACKING (SEL.)
656	RING, 3RD & 4TH CLUTCH BACKING PLATE RETAINER
657	BUSHING, INPUT SUN GEAR (FRONT)
698	PLUG, ORIFICED CUP

*ONLY USED WITH A 4 PLATE CLUTCH PACK.

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Figure 93 Input Clutch Assembly

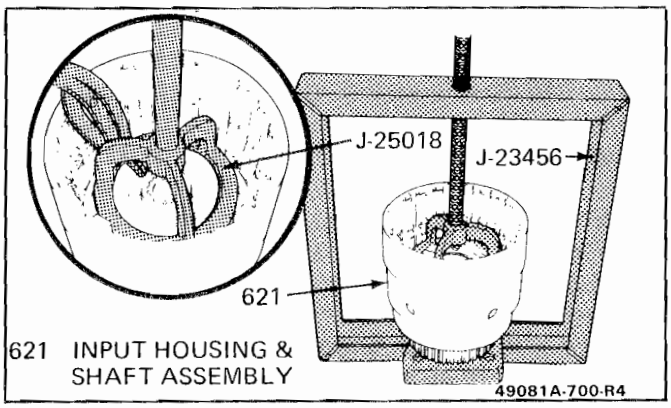


Figure 94 Overrun Clutch Retainer Ring - Removal

- Four turbine shaft oil seal rings (619) and their ring grooves for damage, burrs, or cuts
  - these seals must fit freely into the ring grooves.
- Check valve retainer and ball assembly (617) for damage
  - the ball must move freely in the retainer.
  - the retainer must be tight in the turbine shaft.

Check Valve Retainer and Ball Assembly - Replacement Procedures

Remove or Disconnect (Figure 95)

TOOLS REQUIRED:
#4 Screw extractor

1. Straighten the tangs of the retainer and remove the ball.
2. Check valve retainer
   - use #4 Screw Extractor

Install or Connect (Figure 95)

TOOLS REQUIRED:
9.5 mm (3/8") diameter metal rod

- New check valve retainer and ball assembly (617)
  - use the 9.5 mm (3/8") metal rod.
  - seat the retainer 3.0 mm (1/8 in.) below top surface of the turbine shaft.
  - be certain the ball is loose.

Inspect

- Turbine shaft "O" ring seal (618) for nicks, cuts, or damage
- Input housing check valve ball (620).
  - the ball must move freely.
  - leak check the ball with solvent.

Important (Figure 96)

- If the 3-4 clutch plates are burned or worn and a cause is not found during diagnosis or disassembly, replacement of the retainer and check ball assembly may be required.

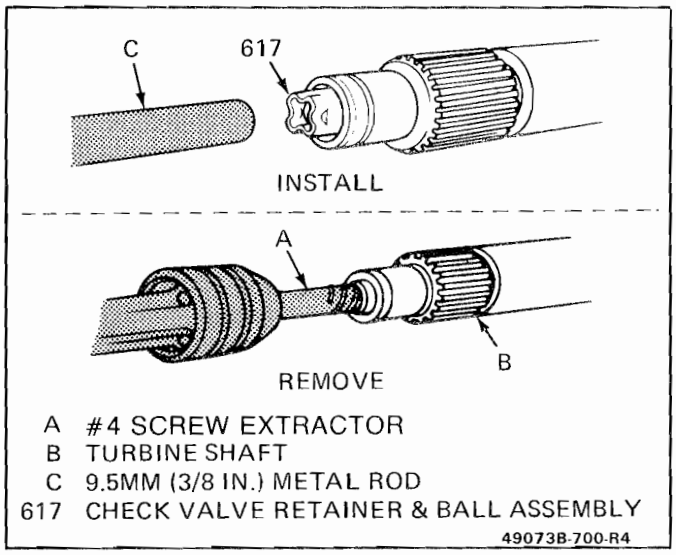


Figure 95 Retainer and Ball Assembly - Replacement

Remove or Disconnect (Figure 92)

TOOLS REQUIRED:
5.715 mm (1/4") diameter rod or drift hammer

1. Tap out retainer and ball assembly.

Install or Connect (Figures 92 and 96)

1. Using same tools, tap in retainer and ball assembly until shoulder is seated in housing.

Inspect (Figure 98)

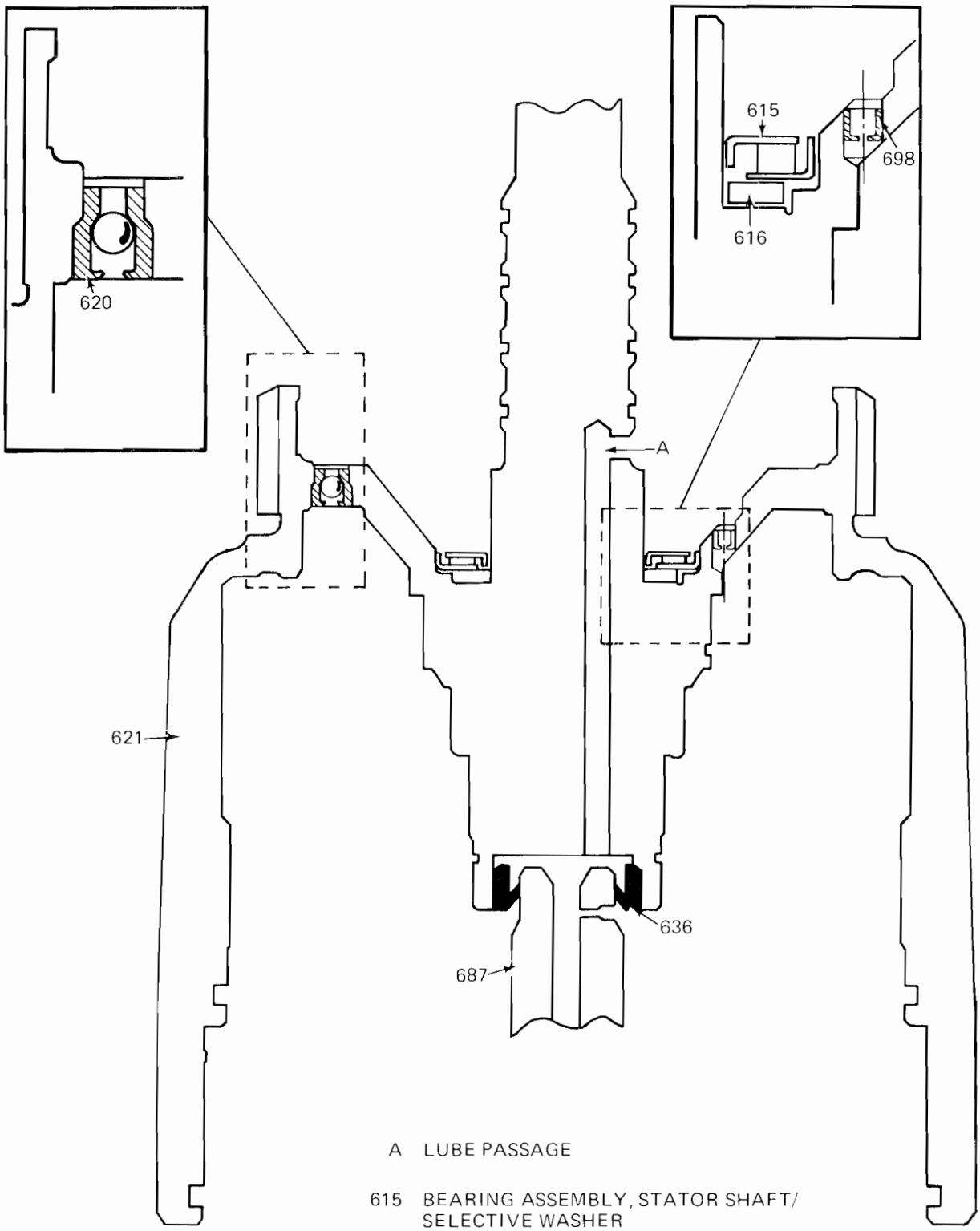
- The 3-4 clutch piston (623) for damage or porosity
- The 3-4 clutch apply ring (625) for
  - bent tangs
  - correct tang length (see chart)
- The 3-4 clutch spring assemby for damage or distortion

Assemble (Figure 99)

1. Position the input housing and shaft assembly on the bench with the turbine shaft through a bench hole.
2. Inner and outer 3-4 clutch lip seals (624) on the 3-4 clutch piston
   - seal lips must face away from the piston hub.
   - lubricate the seals with transmission fluid.
3. The 3-4 clutch piston (623) into the input housing as shown
   - use care not to damage the seals.

Inspect (Figures 93, 100, 102)

- Forward clutch housing (628) for
  - proper check ball operation
  - damage or distortion
  - burrs in seal areas
  - cracks
- Forward clutch piston (630) and overrun clutch piston (632) for

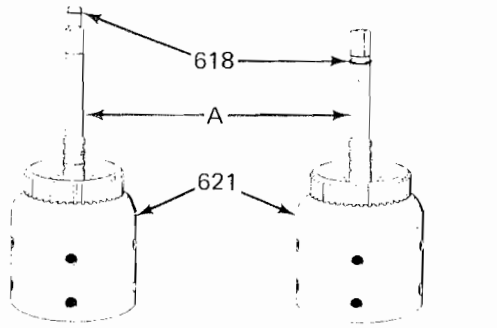


A LUBE PASSAGE

615 BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
620 RETAINER & CHECK BALL ASSEMBLY
621 HOUSING & SHAFT ASSEMBLY, INPUT
636 SEAL, INPUT HOUSING TO OUTPUT SHAFT
687 SHAFT, OUTPUT
698 PLUG, ORIFICED CUP

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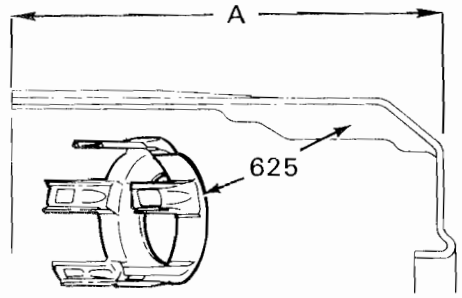
Figure 96 Input Housing Check Valve Ball



A SHAFT, TURBINE
618 SEAL, "O" RING (TURBINE SHAFT/ SELECTIVE WASHER)
621 HOUSING & SHAFT ASSEMBLY, INPUT

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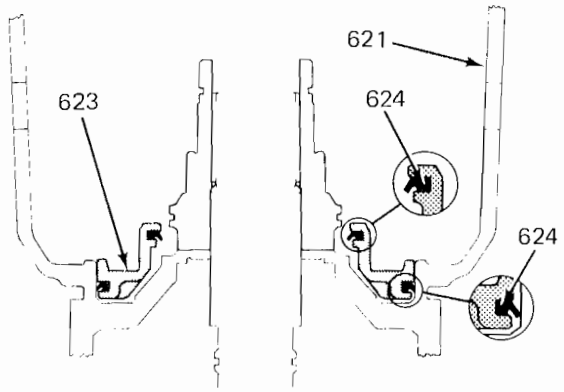
Figure 97 Views of the Input Housing



625 RING, 3RD & 4TH CLUTCH APPLY

MODELS	DIM. A
MCM, MTM, PRM, TAM, TBM, YXM	98.53mm (3.88")
ALL OTHERS	94.13mm (3.71")

Figure 98 The 3-4 Clutch Apply Ring Chart



621 HOUSING & SHAFT ASSEMBLY, INPUT
623 PISTON, 3RD & 4TH CLUTCH
624 SEALS, 3RD & 4TH CLUTCH (INNER & OUTER)

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Figure 99 Input Housing and 3-4 Piston

- porosity or damage
- ring groove damage
- apply leg damage

- Overrun spring assembly (634) for damage or distortion
- Input housing to output shaft lip seal (636) for damage or wear

Assemble (Figures 100 and 101)

TOOLS REQUIRED:
J-23456 Clutch Spring Compressor Press
J-25018 Clutch Spring Compressor
J-29882 Overrun Clutch Inner Seal Protector
J-29883 Forward Clutch Inner Seal Protector

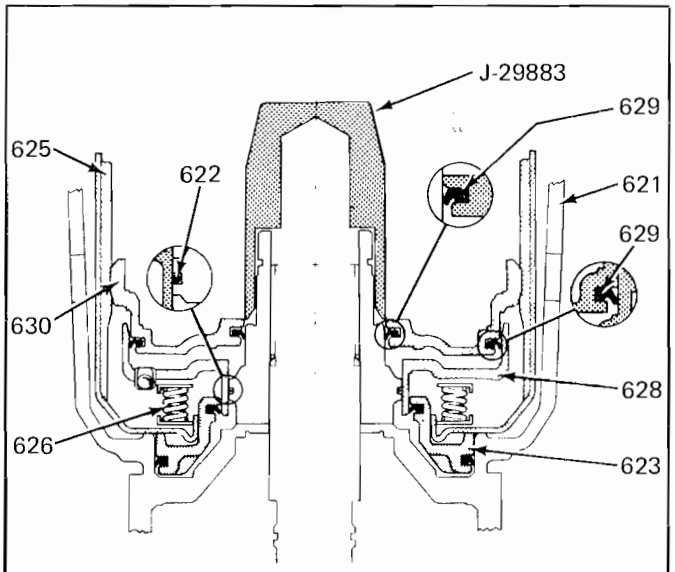
1. Forward clutch housing to input clutch housing "O" ring seal (622) as shown
   - lubricate with transmission fluid.
2. Inner and outer seals (629) on forward clutch piston
   - seal lips must face away from the piston tangs as shown.
   - lubricate with transmission fluid.
3. Forward clutch piston (630) into the forward clutch housing
   - use care not to damage the outer lip seal.
4. The 3-4 clutch spring assembly (626) onto the 3-4 clutch apply ring
5. Forward clutch assembly onto the 3-4 clutch spring assembly
   - the forward clutch piston apply legs must be indexed with the 3-4 clutch apply ring legs.
6. J-29883 on the input housing as shown
7. Apply ring and forward clutch assembly into the input housing as shown
   - hold the assembly by the apply ring legs during installation.
   - do not let the forward clutch piston separate from the housing.
   - firmly seat the assembly.
8. J-29882 on the input housing as shown
9. Overrun clutch piston (632)
   - hub facing upward as shown.
   - if all parts are properly seated to this point, the overrun piston hub will be approximately 3/16 in. below the snap ring groove in the input housing hub.

Assemble (Figures 102 and 103)

1. Overrun clutch spring assembly (634) onto the overrun clutch piston.
   - locate the springs on the piston tabs
2. J-23456 and J-25018 onto the overrun spring assembly.
   - compress springs (Do not over-compress).
3. Retainer snap ring (635) into the snap ring groove
4. Input housing to output shaft lip seal (636)

Inspect

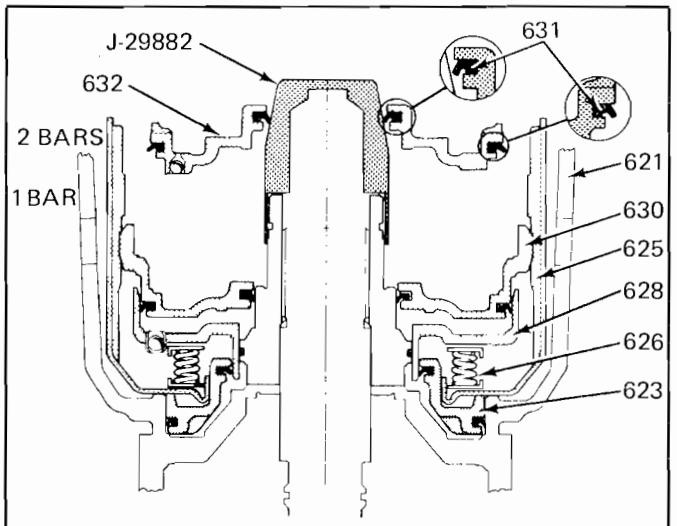
- Overrun clutch plates (645)



621 HOUSING & SHAFT ASSEMBLY, INPUT
622 SEAL, O-RING (INPUT/FWD. HSG.)
623 PISTON, 3RD & 4TH CLUTCH
625 RING, 3RD & 4TH CLUTCH APPLY
626 SPRING ASSEMBLY, 3RD & 4TH CLUTCH
628 HOUSING, FORWARD CLUTCH
629 SEALS, FWD. CLUTCH (INNER & OUTER)
630 PISTON, FORWARD CLUTCH

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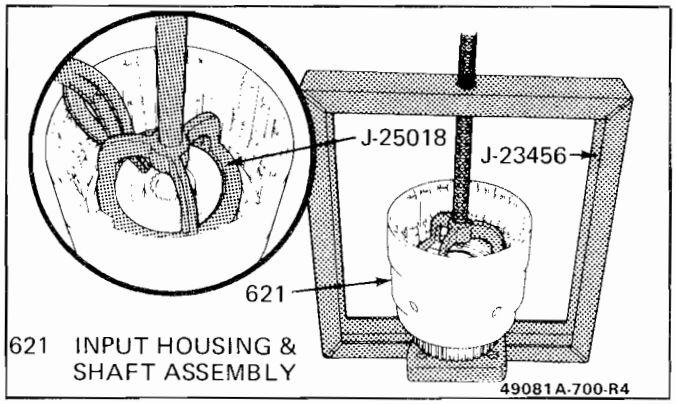
Figure 100 Forward Clutch and 3-4 Apply Ring - Installed



ILL. NO.	DESCRIPTION
621	HOUSING & SHAFT ASSEMBLY, INPUT
623	PISTON, 3RD & 4TH CLUTCH
625	RING, 3RD & 4TH CLUTCH APPLY
626	SPRING ASSEMBLY, 3RD & 4TH CLUTCH
628	HOUSING, FORWARD CLUTCH
630	PISTON, FORWARD CLUTCH
631	SEAL, OVERRUN CLUTCH (INNER & OUTER)
632	PISTON, OVERRUN CLUTCH

49101A-700-R4

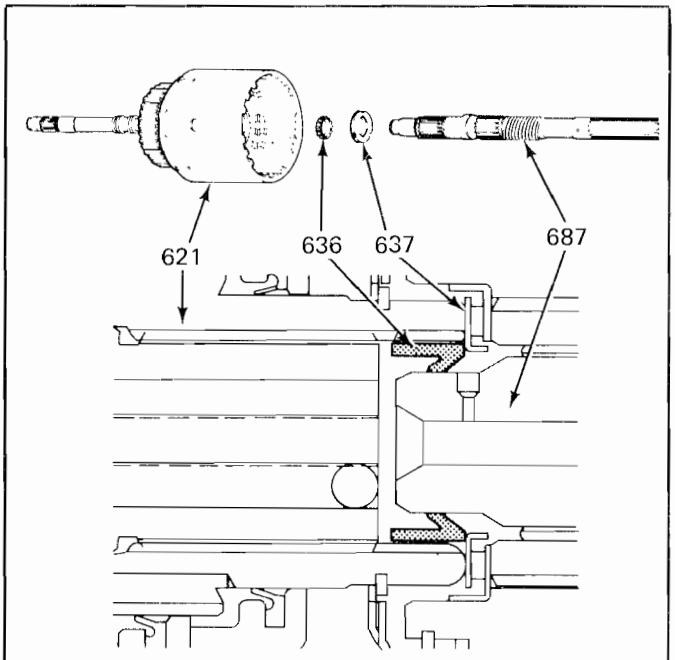
Figure 101 Overrun Piston - Installed



621 INPUT HOUSING & SHAFT ASSEMBLY

49081A-700-R4

Figure 102 Overrun Clutch Retaining Ring - Installed



621 HOUSING & SHAFT ASSEMBLY, INPUT
636 SEAL, INPUT HOUSING TO OUTPUT SHAFT
637 BEARING ASSEMBLY, INPUT SUN GEAR
687 SHAFT, OUTPUT

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Figure 103 Input Hsg. to Output Shaft Lip Seal

- Composition plates for damaged tangs, delamination, or excessive wear
- Steel plates for damaged tangs, wear, or heat damage

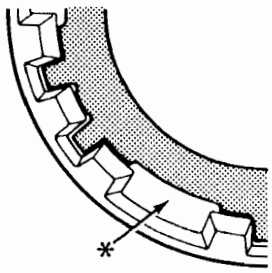
- Input sun gear bearing assembly (637) for wear, flatness or damage

Assemble (Figures 104 and 105)

1. Overrun clutch plates (645) into the input housing.
   - overrun clutch plates are the smallest of the three sets of plates in the input housing.
   - index the plate as shown.
2. Thrust bearing assembly (637) onto the input clutch hub
   - the inside race must face the input housing hub.

- retain with petrolatum.

3. Align the tangs on the two composition overrun clutch plates.



OVERRUN

* ALIGN WIDE NOTCHES TO CASE LUGS

OVERRUN CLUTCH

MODEL	FLAT STEEL		COMP. FACED	
	NO.	THICK-NESS	NO.	THICK-NESS
ALL MODELS	2	2.34 mm (.091")	2	2.03 mm (.079")

49043A-700-R4

Figure 104 Overrun Clutch Plate Chart

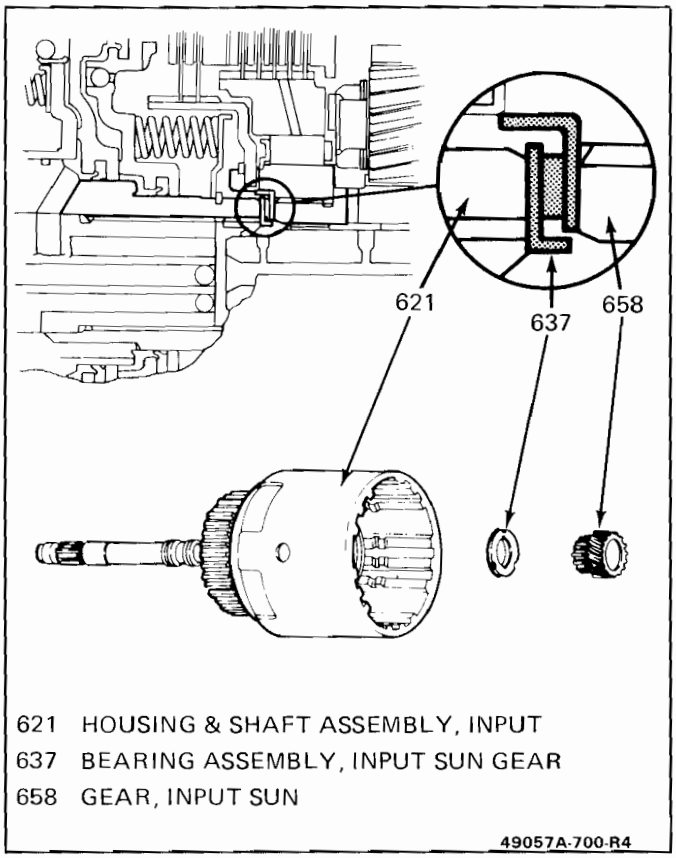
Forward Clutch Sprag Assembly

Disassemble (Figure 106)

1. Forward sprag outer race (644)
2. Overrun clutch hub retaining snap ring (638) and clutch hub (639)
3. Forward clutch retainer and race assembly (641)

Inspect

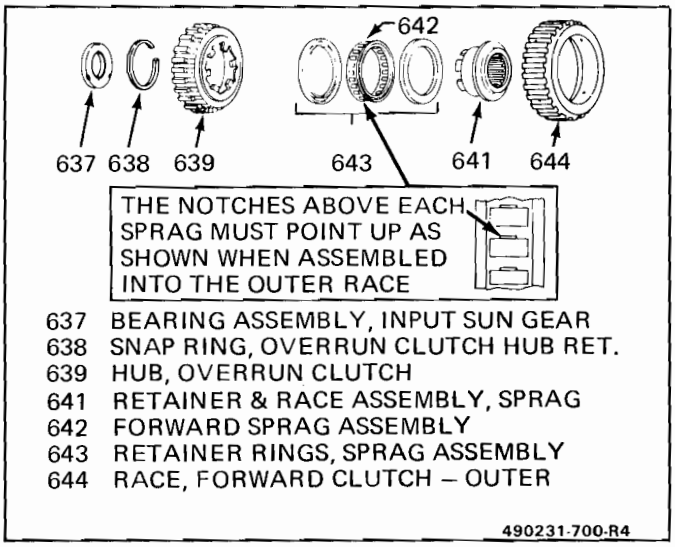
- Forward clutch sprag assembly (642) for
  - wear or damage
  - weak or broken springs
  - damaged or missing retainer caps (brass)
- Overrun clutch hub (639) for
  - spline damage
  - plugged lubrication holes
  - damaged tangs
  - cracks
- Forward clutch retainer and race assembly (641) for
  - spline damage
  - ring groove damage
  - surface finish damage
  - loose retainer



621 HOUSING & SHAFT ASSEMBLY, INPUT
637 BEARING ASSEMBLY, INPUT SUN GEAR
658 GEAR, INPUT SUN

49057A-700-R4

Figure 105 Input Sun Gear Thrust Bearing



637 BEARING ASSEMBLY, INPUT SUN GEAR
638 SNAP RING, OVERRUN CLUTCH HUB RET.
639 HUB, OVERRUN CLUTCH
641 RETAINER & RACE ASSEMBLY, SPRAG
642 FORWARD SPRAG ASSEMBLY
643 RETAINER RINGS, SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH – OUTER

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Figure 106 Forward Clutch Sprag Assembly

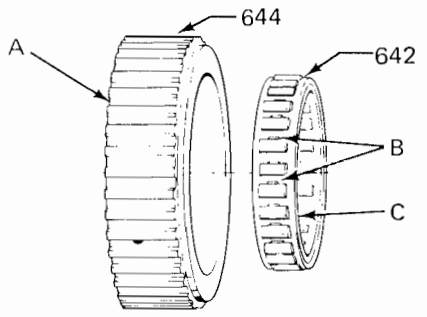
- Forward sprag outer race (644) for
  - spline damage
  - surface finish damage
  - plugged lubrication holes

Assemble (Figures 107, 108, 109)

1. Forward clutch sprag assembly (642) into the outer race
   - to correctly install, the notches in the sprag cage must face upward as shown.
2. One (brass) sprag retainer ring (643) onto the race and retainer assembly

- the flange on the retainer ring must face away from the retainer.

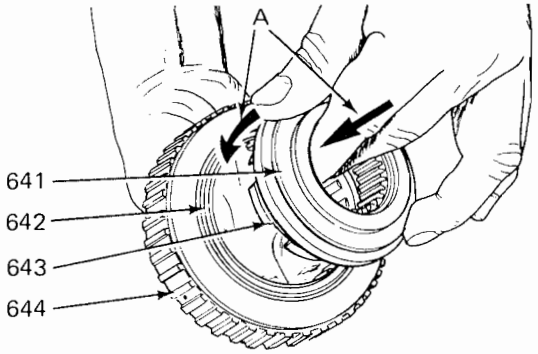
3. Race and retainer assembly into the sprag assembly
   - to assemble, hold the outer race in your left hand with your fingers supporting the sprag at the recessed side of the outer race.
   - insert the race and retainer assembly by pushing in and turning to the left.
4. The remaining (brass) retainer ring onto the sprag assembly
5. Overrun clutch hub (639) onto the wear plate
6. Overrun clutch hub retaining snap ring (638) into the snap ring groove of the race and retainer assembly
7. Test the assembly for proper operation as shown.
   - If the assembly operates backwards, you have installed the sprag backwards. Reassemble correctly.



A RECESSED FACE
B NOTCHES POINT UPWARD AS SHOWN
C LIPPED EDGE
642 FORWARD SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH – OUTER

490245-700-R4

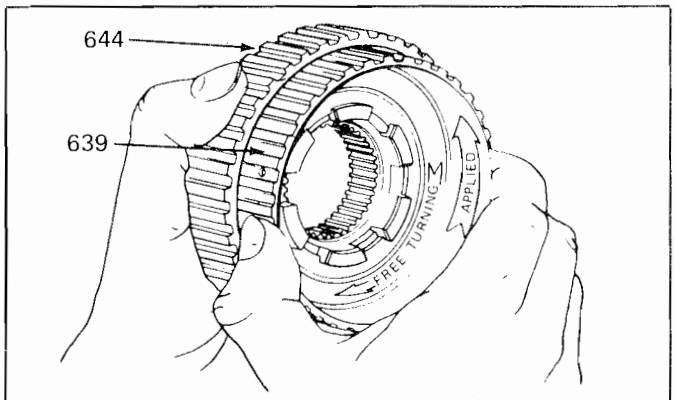
Figure 107 Sprag Assembly Procedure



A PUSH IN AND TURN COUNTERCLOCKWISE TO INSTALL
641 RETAINER & RACE ASSEMBLY, SPRAG
642 FORWARD SPRAG ASSEMBLY
643 RETAINER RINGS, SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH – OUTER

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Figure 108 Sprag Race and Retainer Assembly Procedure



THE OVERRUN CLUTCH HUB MUST TURN CLOCKWISE, BUT NOT COUNTERCLOCKWISE

639 HUB, OVERRUN CLUTCH
644 RACE, FORWARD CLUTCH - OUTER

49112B-700-R4

Figure 109 Check Sprag for Proper Operation

Assemble

- Forward clutch sprag assembly into the input clutch housing
  - index the overrun clutch hub into the overrun clutch plates.

Inspect (Figure 110 and 111)

- Forward (649) and 3-4 clutch plates (654)
  - Composition plates for damaged tangs, delamination, or wear
  - Steel plates for damaged tangs, wear, or heat damage
- Forward (650) and 3-4 clutch backing plates (655) for
  - flatness
  - surface finish damage
  - burrs or nicks
- Forward clutch apply plate (646) and spacer plate (647) for
  - flatness
  - surface finish damage
  - burrs or nicks
- The 3-4 clutch apply plate (653) for
  - flatness
  - surface finish damage
- The 3-4 clutch ring retainer plate (652) for
  - bent tangs
  - flatness

Assemble (Figures 110, 111, 112 and 113)

1. Forward clutch apply plate (646) into the input clutch housing
   - index as shown.
2. Waved steel forward clutch plate (648) into the input clutch housing
   - index as shown.
3. The remaining forward clutch plates (649) into the input clutch housing
   - start with steel plate and alternate with a composition

4. Forward clutch selective backing plate (650)
5. Forward clutch retaining ring (651)

Forward Clutch Piston Travel Check

Measure (Figure 112A)

Check the end clearance between the backing plate (650) and the retaining ring (651) with two feeler gages.

- Select the proper backing plate from the chart to obtain the correct clearance

Assemble

1. The 3-4 ring retainer plate (652)
   - index each leg into the apply ring legs.
2. The 3-4 clutch apply plate (653)
3. The 3-4 clutch plates (654)
   - start with composition and alternate with steel
4. The 3-4 clutch backing plate (655) and retainer ring (656)
   - chamfered side up.

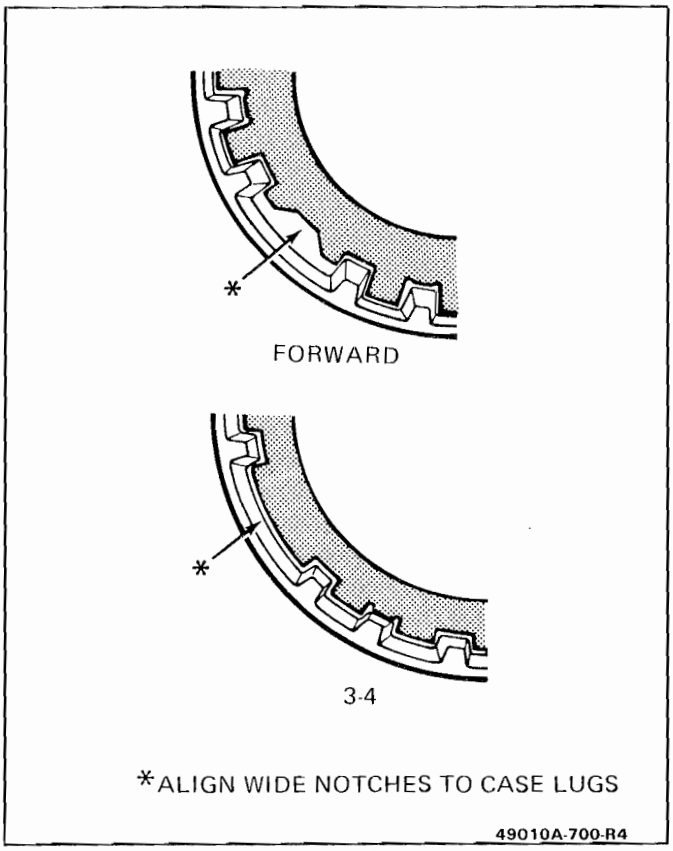
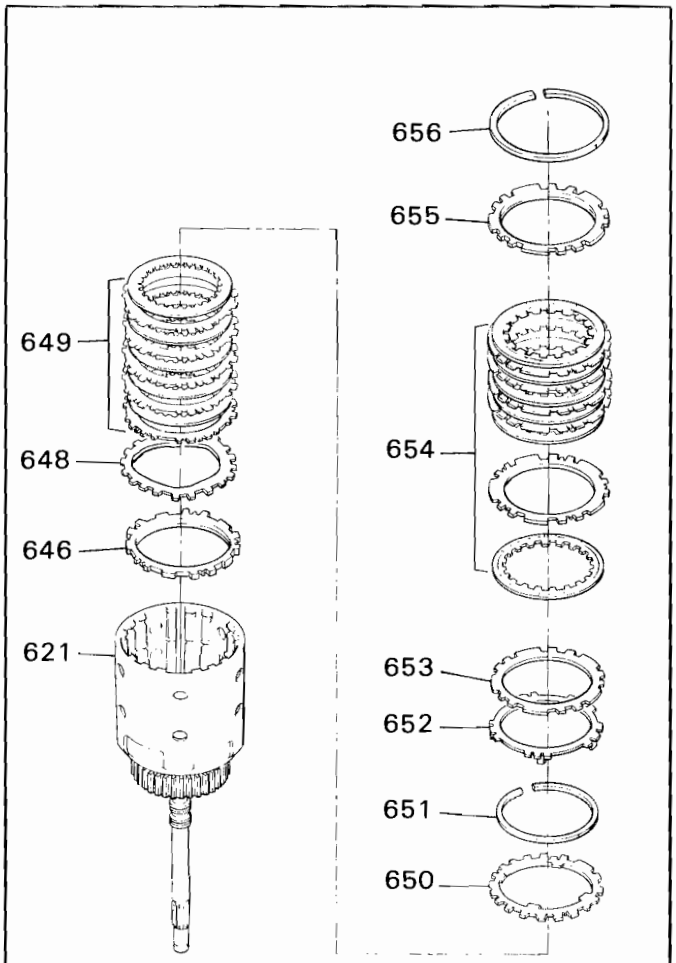


Figure 110 Forward and 3-4 Clutch Plates - Installed

3-4 Clutch Piston Travel Check

Measure (Figure 114)

- Check the end clearance between the backing plate (655) and the first composition plate with a feeler gage.



ILL. NO.	DESCRIPTION
621	HOUSING & SHAFT ASSEMBLY, INPUT
646	PLATE, FORWARD CLUTCH APPLY
648	PLATE, FORWARD CLUTCH (WAVED)
649	PLATE ASSEMBLY, FORWARD CLUTCH
650	PLATE, FORWARD CLUTCH BACKING (SEL.)
651	RING, FORWARD CLUTCH BACKING PLATE RETAINER
652	PLATE, 3RD & 4TH CLUTCH RING RETAINER
653	PLATE, 3RD & 4TH CLUTCH APPLY
654	PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655	PLATE, 3RD & 4TH CLUTCH BACKING (SEL.)
656	RING, 3RD & 4TH CLUTCH BACKING PLATE RETAINER

Figure 111 Input Housing with Forward and 3-4 Clutch Plates

FORWARD CLUTCH INFORMATION CHART

PLATE TYPE	THICK-NESS	QUANTITY REQUIRED ALL MODELS
FLAT STEEL CLUTCH PLATE	2.29mm (.090")	5
COMPOSITION FACED CLUTCH PLATES	1.78mm (.070")	5
APPLY PLATE	6.44mm (.251")	1
WAVED STEEL CLUTCH PLATE	2.03mm (.079")	1
BACKING PLATE	SELEC-TIVE	1

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Figure 112 Forward Clutch Plate Chart

- Select the proper backing plate from the chart to obtain the correct clearance.

Clutch Air Check

(Figure 115)

Air check the 3-4, forward, and overrun clutches by applying air pressure at the feed holes in the turbine shaft. (When the overrun clutch is checked, the air well blow by the forward clutch piston lip seals and exit out the forward clutch feed hole in the turbine shaft.)

Assemble (Figure 116)

TOOLS REQUIRED:
J-36418-1 seal installer
J-36418-2 seal sizer

1. Install four turbine shaft oil seal rings (619) using J-36418-1
   - Adjust screw to obtain proper height
2. Use J-36418-2 to size the seals after installation

Reverse Input Clutch Assembly

Disassemble (Figure 118 and 119)

TOOLS REQUIRED:
J-23327 Clutch Spring Compressor
J-25018 Clutch Spring Compressor Adaptor

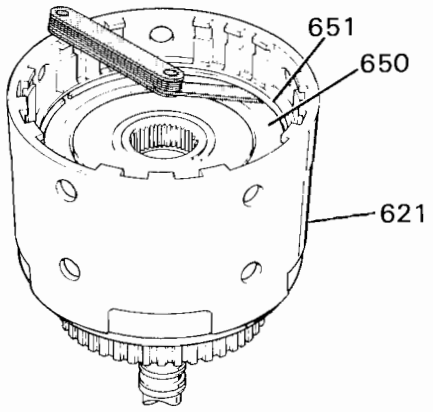
1. Retaining ring (614) from reverse input housing
2. Backing plate (613)
3. Clutch plates (612) and waved steel plate (611)
4. Install J-23327 and J-25018.
   - compress the spring assembly.

FORWARD CLUTCH BACKING PLATE SELECTION

ALL MODELS

BACKING PLATE TRAVEL = .075mm - 1.55mm (.030" - .060")

PLATE THICKNESS	IDENTIFICATION
6.97mm - 7.07mm (.274" - .278")	1
6.38mm - 6.48mm (.250" - .255")	2
5.79mm - 5.89mm (.227" - .232")	3
5.20mm - 5.30mm (.205" - .208")	4
4.61mm - 4.71mm (.180" - 185")	5



621 HOUSING & SHAFT ASSEMBLY, INPUT
650 PLATE, FORWARD CLUTCH BACKING
651 RING, FORWARD CLUTCH BACKING PLATE RETAINER

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Figure 112A Forward Clutch Backing Plate Travel

5. Spring assembly retainer ring (610) and spring assembly (609)
6. Reverse input clutch piston (607)
   - inner and outer lip seals (608) from piston

Inspect (Figures 118, 120 and 121)

- Backing plate (613) for
  - damage
  - distortion or flatness
  - burrs or surface finish damage
- Clutch Plates (612)
  - Composition for tang damage, delamination, or wear
  - Steel for tang damage, wear, or heat damage
- Spring assembly (609) for distortion or damage
- Piston (607) for
  - dishing or deforming
  - seal retaining rings loose
- Housing and drum assembly (605) for
  - damaged or worn bushings (603 and 606)
  - surface on the hub and outer housing

3-4 CLUTCH INFORMATION CHART

PLATE TYPE	THICK-NESS	QUANTITY REQUIRED	
		*A-MODELS	*B-MODELS
FLAT STEEL CLUTCH PLATE	1.97mm (.077")	4	5
COMPOSITION FACED CLUTCH PLATES	2.03mm (.079")	5	6
APPLY PLATE	3.30mm (.130")	1	1
BACKING PLATE	SELEC-TIVE	1	1

*A-MODELS	MCM, MTM, PRM, TAM, TBM, YXM
*B-MODELS	ALL OTHERS

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Figure 113 3-4 Clutch Plate Chart

- retainer and ball assembly moving freely (leak check with solvent).
- leak at the weld

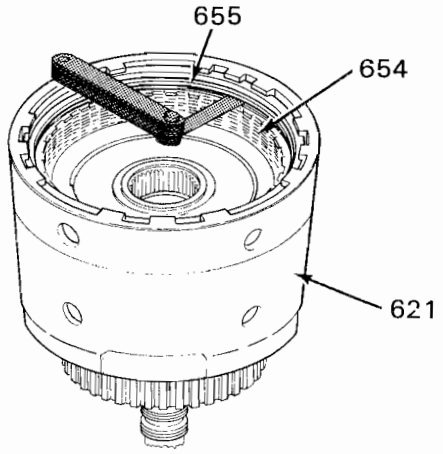
Assemble (Figures 118, 119, 122 and 123)

TOOLS REQUIRED:
J-23327 Clutch Spring Compressor
J-25018 Clutch Spring Compressor Adaptor

1. Inner and outer seals (608) on the piston
   - lips must face away from the hub as shown.
   - lubricate with transmission fluid.
2. Piston (607) into the housing and drum assembly
   - use an 8 mm feeler gage to position the lip seals.
   - use care not to damage the seals.
3. Spring assembly (609)
   - large opening in the assembly goes towards the piston.
4. Install J-23327 and J-25018.
   - compress the spring assembly
   - install the retainer ring (610).
5. Waved steel clutch plate (611)
6. Clutch plates (612).
   - start with a composition and alternate with steel
   - see chart for correct number of clutch plates.
7. Backing plate (613)
   - chamfered side up
8. Retaining ring (614)

3-4 BACKING PLATE SELECTION

MODEL	BACKING PLATE TRAVEL	*BACKING PLATE	
		Use Backing Plate Which Gives Correct Travel	
		DIM.	I.D.
MCM, MTM, PRM, TAM, TBM, YXM	1.39 - 2.78 mm (.055" - .109")	7.125 mm (.278")	1
		6.125 mm (.239")	2
ALL OTHERS	1.25 - 2.87 mm (.049" - .113")	5.125 mm (.200")	3
		4.125 mm (.161")	4



621 HOUSING & SHAFT ASSEMBLY, INPUT
654 PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655 PLATE, 3RD & 4TH CLUTCH BACKING

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Figure 114 Backing Plate Selection Chart

Reverse Input and Input Clutches

Assemble (Figures 124 and 125)

1. Selective thrust washer (616) onto the input housing
2. Bearing assembly (615)
   - inside (black race) goes toward the oil pump.
3. Reverse input clutch assembly (605) onto the input clutch assembly
   - index the reverse input clutch plates with the input clutch hub.
   - make certain all clutches are fully engaged.

Assemble (Figure 126)

- Reverse input and input clutch assembly into the transmission case
  - index the 3-4 clutch plates with the input internal gear.
  - make sure all clutch plates are fully engaged.

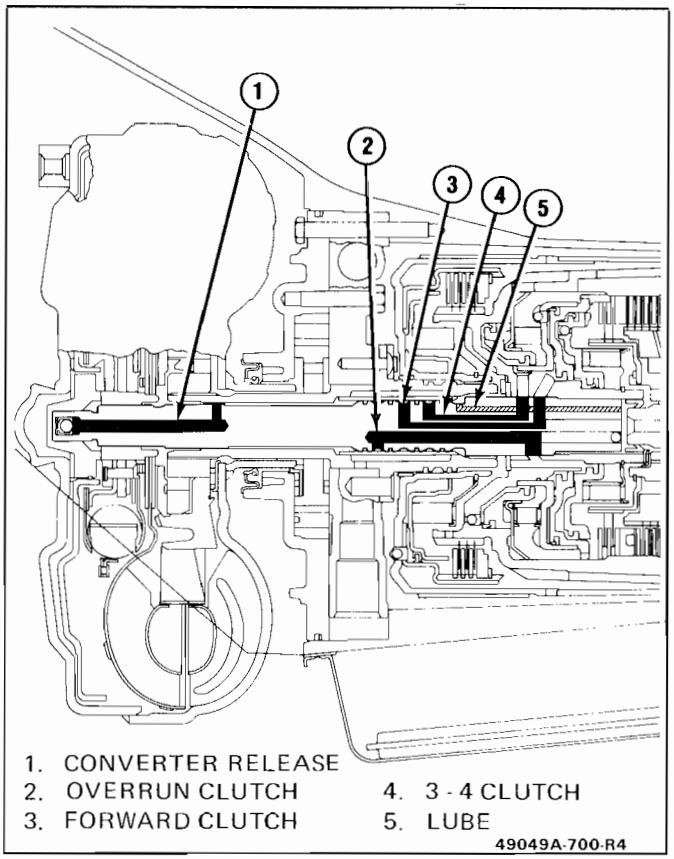


Figure 115 Turbine Shaft Oil Passages

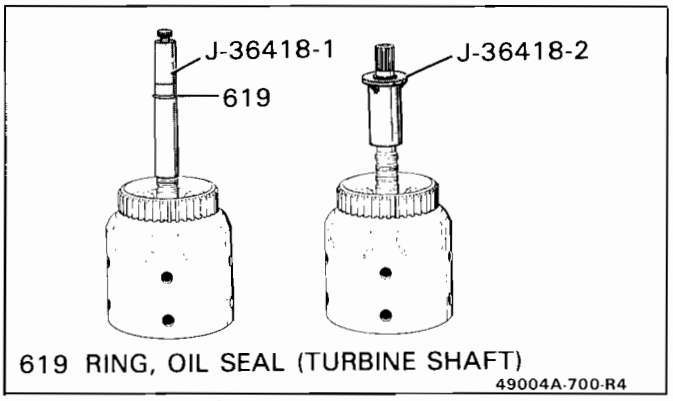


Figure 116 Turbine Shaft Oil Seal Rings

- when properly assembled, the reverse input clutch housing will be located just below the case oil pump face.

2-4 Band Assembly

Inspect

- 2-4 band assembly (602) for damage or wear

Assemble (Figure 126, 127)

1. The 2-4 band assembly (602) into the case
   - index the band anchor pin end with the case pin hole.
2. Band anchor pin (48) into the case
   - index the pin into the 2-4 band.

Oil Pump Assembly

Remove or Disconnect (Figure 130)

1. Thrust washer (601)
2. Pump cover to case gasket (9)
3. Pump to case oil seal (8)
4. Pump cover bolts (236)
5. Pump cover (217) from pump body (203)

Pump Body

Disassemble (Figure 130)

1. Pump slide spring (209)
   - compress with needle nose pliers.
   - pull straight out.

   CAUTION: Spring is under very high pressure. Place covering over spring to prevent possible injury.
2. From the pump pocket
   - Pump guide rings (212)
   - Pump vanes (215)
   - Pump rotor (214)
   - Pump guide (213)
   - Slide (206)
   - Slide Seal (211)
   - Seal Support (210)
   - Pivot slide pin (208) and spring (207)
   - Slide seal ring (204) and slide back up seal (205)
3. Retainer (94), oil seal assembly (2)
   - pry out with a screwdriver.

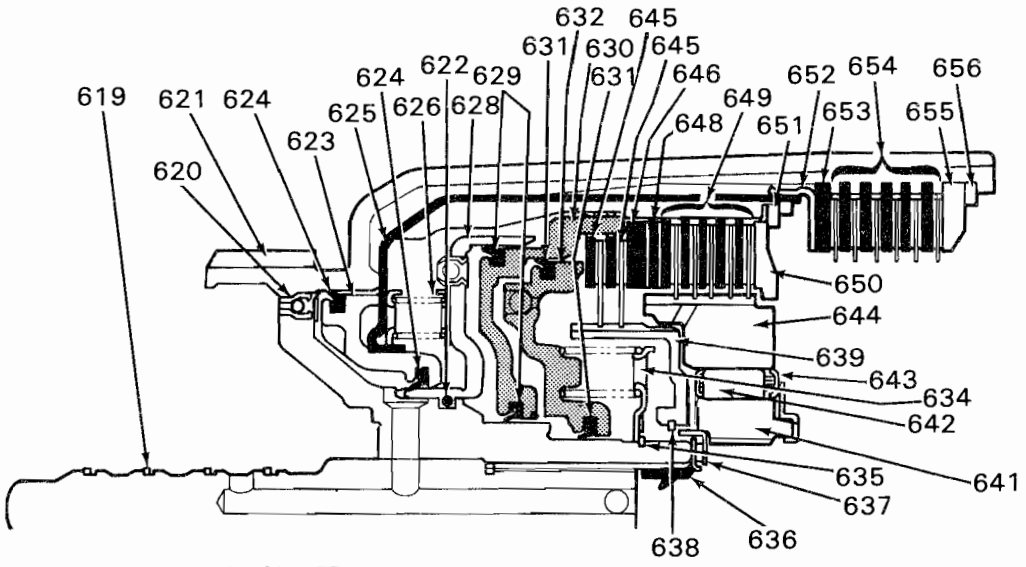
Oil Pump Cover

Disassemble (Figures 130)

1. Converter clutch apply valve train
   - compress converter clutch apply valve spring (228) with a screwdriver.
   - remove retaining ring (225).
   - slowly release the spring tension.
   - stop valve (226), converter clutch apply valve (227), and two converter clutch valve springs.
2. Pressure relief ball (231)
   - ball is under strong spring pressure.
   - cover the ball with a cloth when removed.
3. Pressure regulator assembly (218-224).
   - follow the same procedure used to remove the converter clutch valve.

Inspect

- Pressure regulator valve assembly (218-224) and converter clutch apply valve assembly (225-229) for
  - chips, burrs, distortion, plugged oil passage, and free movement in bore
  - remove burrs with crocus cloth
- Pressure relief assembly (230-232) for damage or distortion



619 RING, OIL SEAL (TURBINE SHAFT)
620 RETAINER & CHECK BALL ASSEMBLY
621 HOUSING & SHAFT ASSEMBLY, INPUT
622 SEAL, "O" RING INPUT TO FORWARD HSG.
623 PISTON, 3RD & 4TH CLUTCH
624 SEAL, 3RD & 4TH CL. (INNER & OUTER)
625 RING, 3RD & 4TH CLUTCH APPLY
626 SPRING ASSEMBLY, 3RD & 4TH CLUTCH
628 HOUSING, FORWARD CLUTCH
629 SEAL, FORWARD CLUTCH (INNER & OUTER)
630 PISTON, FORWARD CLUTCH
631 SEAL, OVERRUN CLUTCH (INNER & OUTER)
632 PISTON, OVERRUN CLUTCH
634 SPRING ASSEMBLY, OVERRUN CLUTCH
635 SNAP RING, OVERRUN CLUTCH SPRING RETAINER
636 SEAL, INPUT HOUSING TO OUTPUT SHAFT
637 BEARING ASSEMBLY, INPUT SUN GEAR
638 SNAP RING, OVERRUN CL. HUB RETAINING
639 HUB, OVERRUN CLUTCH
641 RETAINER & RACE ASSEMBLY, SPRAG
642 FORWARD SPRAG ASSEMBLY
643 RETAINER RINGS, SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH (OUTER)
645 PLATE ASSEMBLY, OVERRUN CLUTCH (STEEL & COMP.)
646 PLATE, FORWARD CLUTCH APPLY
648 PLATE, FORWARD CLUTCH (WAVED)
649 PLATE ASSEMBLY, FORWARD CLUTCH
650 PLATE, FORWARD CLUTCH BACKING (SEL.)
651 RING, FORWARD CLUTCH BACKING PLATE RETAINER
652 PLATE, 3RD & 4TH CLUTCH RING RETAINER
653 PLATE, 3RD & 4TH CLUTCH APPLY
654 PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655 PLATE, 3RD & 4TH CLUTCH BACKING (SEL.)
656 RING, 3RD & 4TH CLUTCH BACKING PLATE RETAINER

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Figure 117 Input Clutch Assembly

- Pump cover (217) and pump body (203) for
  - worn or damaged bushings (see Bushing Replacement Procedure)
  - foreign material or debris
  - porosity
  - scored or irregular mating faces
  - cross channel leaks
  - ring groove damage
- Rotor (214) and slide (206) for cracks
- Oil seal assembly for damage or wear

Clean

- Wash and air dry all parts.
  - do not wipe dry with a cloth.

Measure (Figure 129)

TOOL REQUIRED:
One inch Mircormeter

- Oil pump rotor (214) thickness
- Oil pump slide (206) thickness

Important

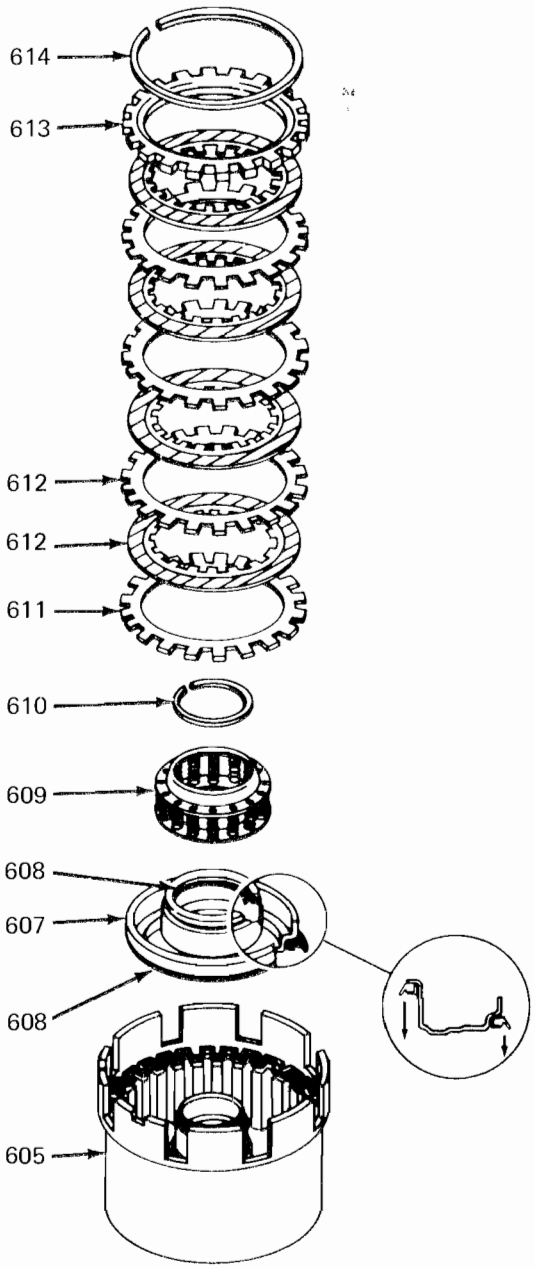
Measurement of rotor/slide must be made on undamaged surfaces. Select similar size replacements. Lightly hone both sides of replacement rotor or slide to remove any nicks or burrs.

Pump Body

Assemble (Figures 130, 131 and 132)

TOOL REQUIRED:
J-25016 Seal Installer

1. "O" ring seal (205) and oil seal ring (204) into the groove on the back side of the slide
   - retain with petrolatum.
2. Pivot pin spring (207) and pivot pin (208) into the pump body
3. Slide (206)
   - index the notch in the slide with the pivot pin.
   - the oil seal ring must face downward into the pump pocket.



ILL. NO.	DESCRIPTION
605	HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
607	PISTON ASSEMBLY, REVERSE INPUT CLUTCH
608	SEALS, REVERSE INPUT CLUTCH – INNER
608	SEALS, REVERSE INPUT CLUTCH – OUTER
609	SPRING ASSEMBLY, REVERSE INPUT CLUTCH
610	RING, REVERSE INPUT CLUTCH SPRING RET.
611	PLATE, REVERSE INPUT CLUTCH (WAVED)
612	PLATE ASSEMBLY, REVERSE INPUT CLUTCH (COMPOSITION)
612	PLATE ASSEMBLY, REVERSE INPUT CLUTCH (STEEL)
613	PLATE, REVERSE INPUT CLUTCH BACKING
614	RING, REVERSE INPUT CLUTCH RETAINING

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Figure 118 Reverse Input Clutch Assembly

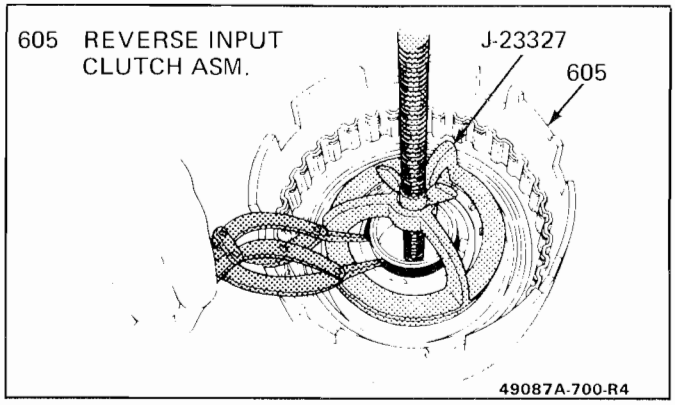


Figure 119 Reverse Input Retainer Ring - Removal

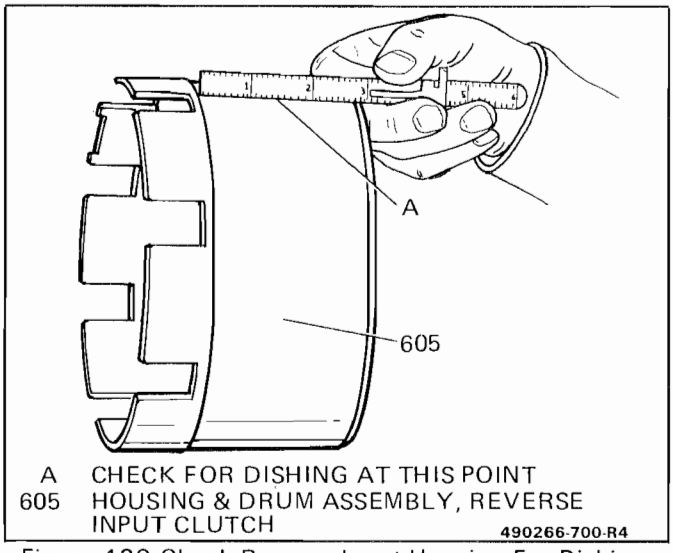


Figure 120 Check Reverse Input Housing For Dishing

4. Slide seal (211) and support (210)
5. Vane guide ring (212)
6. Rotor guide (213) onto the rotor
   - retain with petrolatum.
7. Rotor (214)
   - with guide toward the pump pocket.
8. Vanes (215)
9. Vane guide ring (212)
10. Pump slide spring (209)
11. Oil seal assembly (2), retainer (94)
    - use J-25016

Oil Pump Cover

Assemble (Figures 130, 130L and 133)

1. Pressure relief ball (231), spring (232) and rivet (230)
2. Inner (229) and outer (228) converter clutch valve springs into the converter clutch valve bore
3. Converter clutch valve (227)
4. Stop valve (226)
5. Retaining ring (225)
6. Pressure regulator valve (218) into the pressure regulator bore
7. Pressure regulator valve spring (219)
8. T.V. boost valve (222) into the T.V. bushing

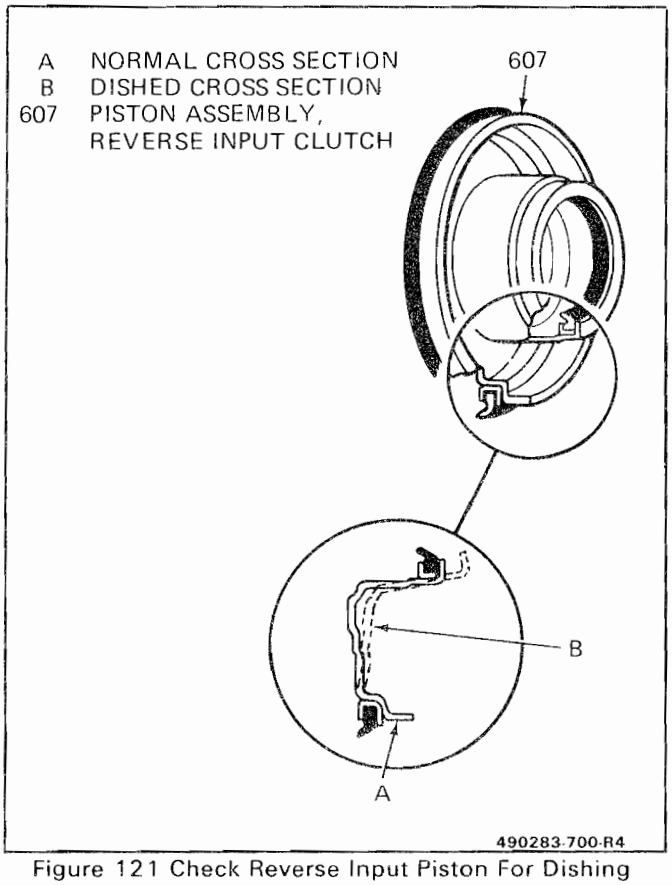


Figure 121 Check Reverse Input Piston For Dishing

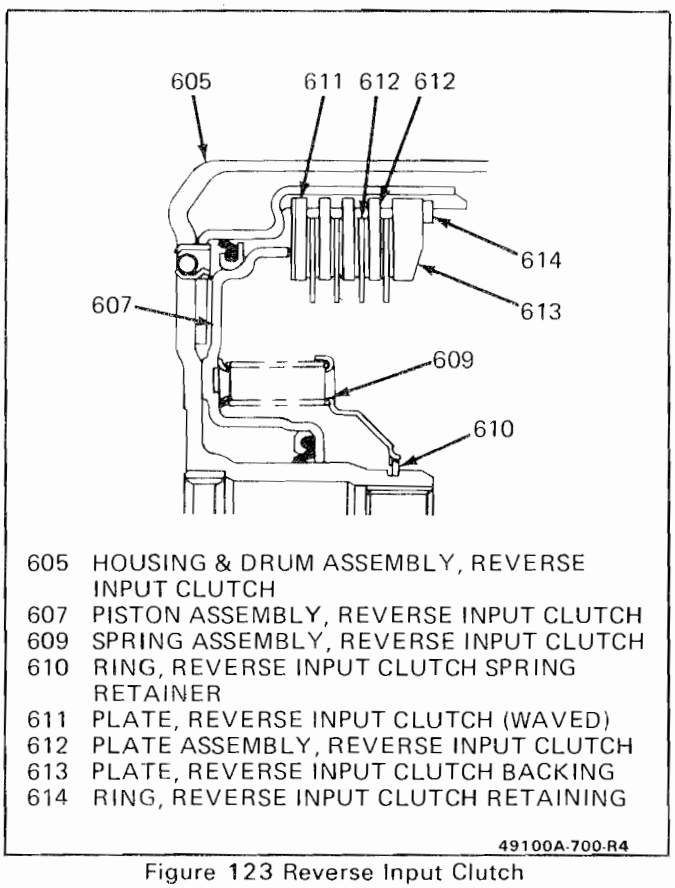


Figure 123 Reverse Input Clutch

REVERSE INPUT CLUTCH

MODEL	FLAT STEEL		COMP. FACED		WAVED STEEL	
	No.	Thick-ness	No.	Thick-ness	No.	Thick-ness
MCM, MTM, PRM, TAM, TBM, YXM	2	1.97mm (.077")	3	2.03mm (.079")	1	2.03mm (.079")
ALL OTHERS	3	1.97mm (.077")	4	2.03mm (.079")	1	2.03mm (.079")

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Figure 122 Reverse Input Clutch Plate Chart

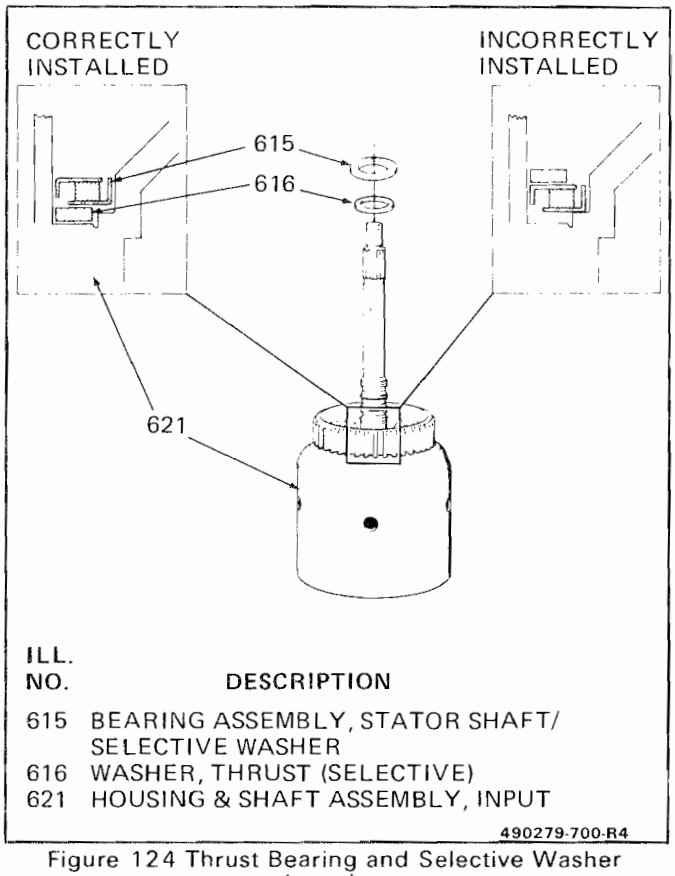
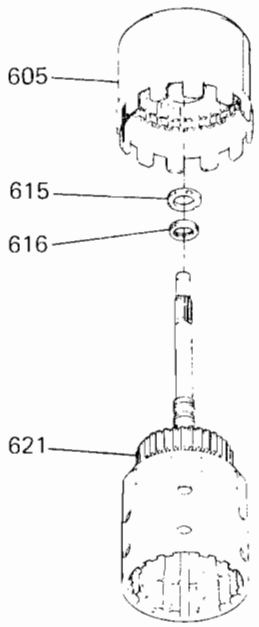


Figure 124 Thrust Bearing and Selective Washer Location

- long land of the valve into the large hole of the bushing.
- retain with petrolatum.

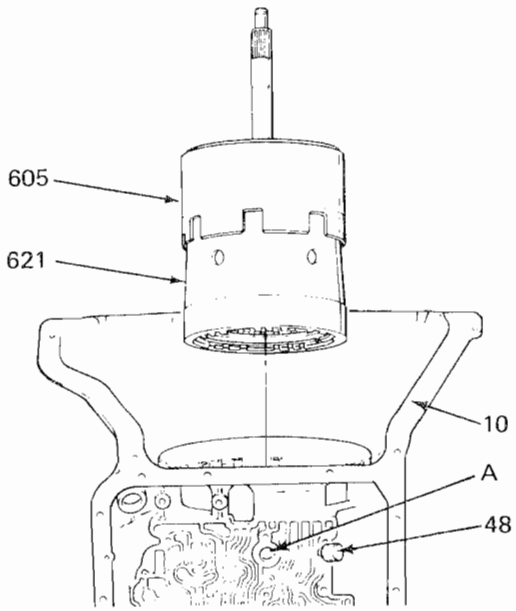
9. Reverse boost valve (220) into the reverse boost valve sleeve
   - small end of the valve first.
   - retain with petrolatum.
10. Reverse boost valve sleeve (221) into the pressure regulator bore
11. T.V. boost valve sleeve (223) into the pressure regulator bore
12. Retainer ring (224)



605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
615 BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
621 HOUSING & SHAFT ASSEMBLY, INPUT

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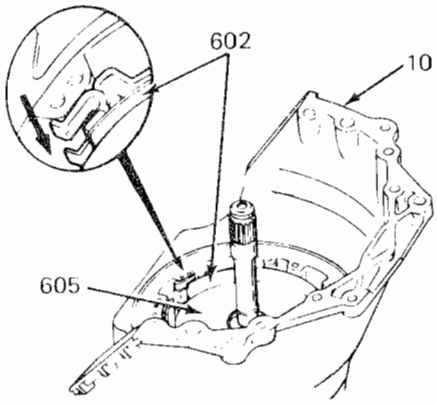
Figure 125 Reverse Input and Input Clutches



A BAND ANCHOR PIN LOCATION
10 CASE, TRANSMISSION
48 PIN, BAND ANCHOR
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
621 HOUSING & SHAFT ASSEMBLY, INPUT

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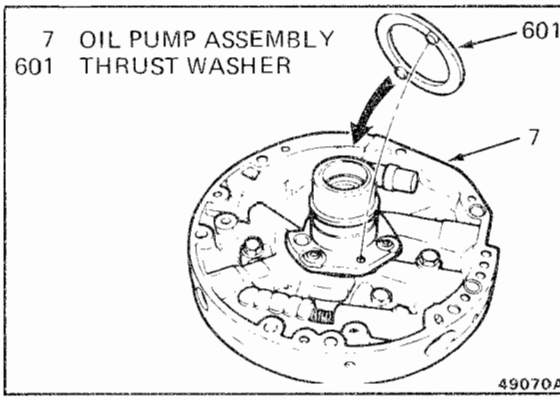
Figure 126 Installing Input Clutch



10 CASE, TRANSMISSION
602 BAND ASSEMBLY, 2-4
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH

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Figure 127 2-4 Band Assembly - Installed



49070A-700-R4

Figure 128 Oil Pump Thrust Washer

Oil Pump Cover and Body

Assemble (Figures 130, 134, 135 and 137)

TOOLS REQUIRED:

J-21368 Oil Pump Body and Cover Alignment Band

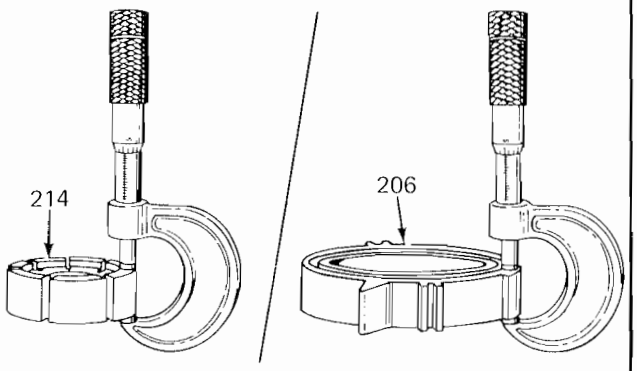
1. Oil pump cover (217) onto oil pump body
   - stator shaft through a bench hole.
2. Pump cover bolts (236)
   - leave finger tight.
3. Align pump cover and pump body with J-21368.
   - place a screwdriver through a bolt hole and into a hole in the bench.
4. Torque attaching bolts to 22 N·m (18 ft. lbs.)
5. Pump to case gasket (009) onto case
   - retain with petrolatum.
6. Oil seal rings (233), if removed previously, onto the pump cover hub
   - retain with petrolatum.
7. Pump to case oil seal (008)
   - do not twist the seal.
   - lubricate with transmission fluid.
8. Thrust washer (601)

OIL PUMP ROTOR SELECTION CHART

THICKNESS (mm)	THICKNESS (in.)
17.948 - 17.961	0.7066 - 0.7071
17.961 - 17.974	0.7071 - 0.7076
17.974 - 17.987	0.7076 - 0.7081
17.987 - 18.000	0.7081 - 0.7086
18.000 - 18.013	0.7086 - 0.7091

OIL PUMP SLIDE SELECTION CHART

THICKNESS (mm)	THICKNESS (in.)
17.948 - 17.961	0.7066 - 0.7071
17.961 - 17.974	0.7071 - 0.7076
17.974 - 17.987	0.7076 - 0.7081
17.987 - 18.000	0.7081 - 0.7086
18.000 - 18.013	0.7086 - 0.7091



206 SLIDE, PUMP
214 ROTOR, OIL PUMP

490288-700-R4

Figure 129 Oil Pump Rotor and Slide Selection

Install or Connect (Figure 137)

TOOLS REQUIRED:
J-25025-1 Alignment Pins

1. J-25025-1 into the case as shown
2. Oil pump assembly into the case
   - align all holes properly.
3. Bolts and washers (5 and 6)
   - torque to 22 N·m (18 ft. lbs.)

Important

Rotate the transmission to a horizontal position. If the transmission is assembled properly the turbine shaft should turn by hand. If not identify and correct the misassembly now.

Transmission End Play Check

Measure (Figures 138, 139, 140, 144)

TOOLS REQUIRED:
J-24773-A End Play Checking Fixture
J-25022 End Play Checking Fixture Adaptor (245 mm)
J-34725 End Play Checking Fixture Adaptor (298 mm)
278 mm (11 in.) Bolt and Nut or J-25025-7A Post
Dial Indicator

1. Remove an oil pump to case bolt and install a 278 mm (11 in.) bolt and lock nut or J-25025-7A.
2. Install J-25022-A or J-34725 as shown.
3. Install J-24773-A as shown.
4. Install a dial indicator.
   - set to zero.
5. Pull up on J-24773-A.
   - End play should be 0.13 - 0.92 mm (.005 - .036 in.).

   The selective washer which controls end play is located between the input housing and the thrust bearing on the oil pump hub. If more or less end play is required, select the proper washer from the chart and install. If dial indicator shows no end play, the selective washer and thrust bearing have been misassembled.

Assemble (Figure 142)

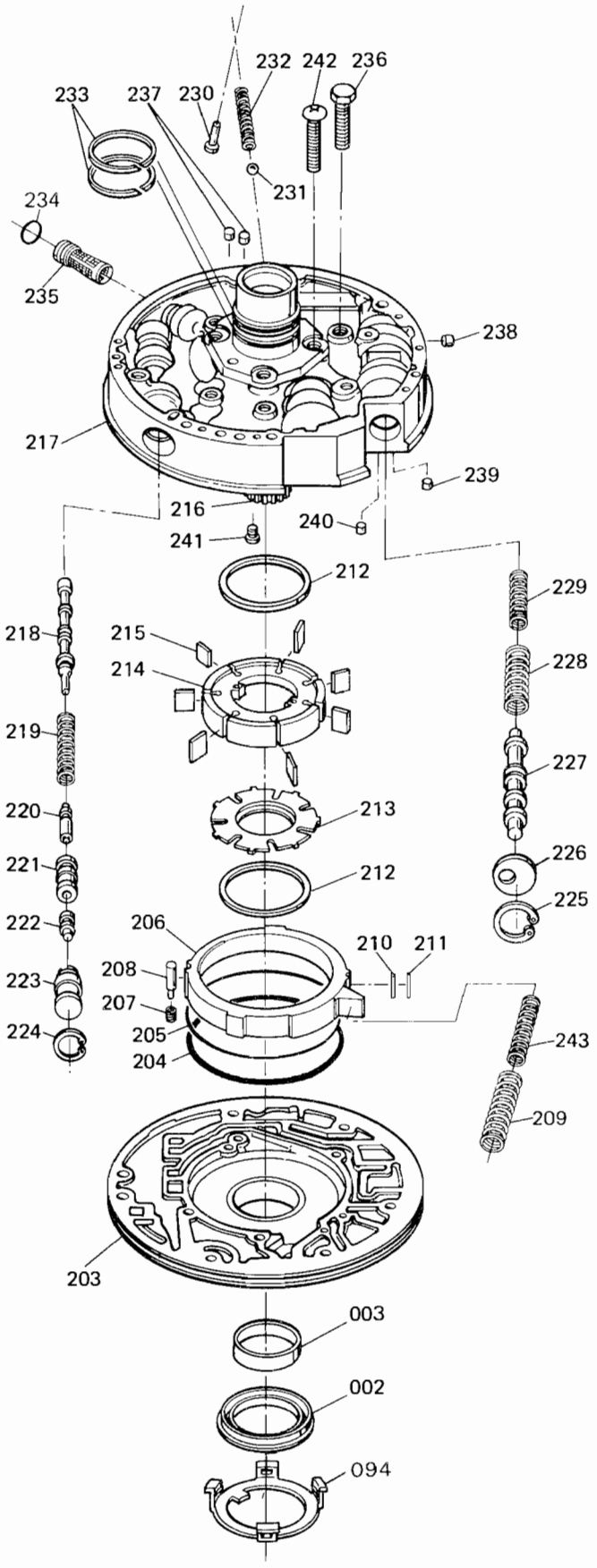
1. "O" ring seal (618) into the groove in the end of the turbine shaft.

Important (Figure 143)

- There should be clearance between the reverse input clutch and the reaction sun gear shell. This clearance can be observed at the point shown in-700-R4 Figure 129. **Do not** try to shim the internal parts because of this clearance.

Inspect (Figure 41 & 145)

- The 1-2 accumulator cover and pin assembly (62) for
  - porosity or damage
  - scored piston wall
  - plugged oil passage
- 1-2 accumulator piston (61) and the 3-4 accumulator piston (52) for
  - porosity
  - ring groove damage
  - pin hole damage
- 1-2 accumulator spring (59) and 3-4 accumulator spring (54) for distortion or damage
- Spacer plate (56) and gaskets (88 and 89) for damage
- Checkballs (55) for damage
- T.V. Link (64) for damage
- Manual detent spring (709) for damage
- Oil filter (71) for
  - cut or damaged "O" ring seal (70)
  - cracks in the neck or body



ILL. NO.	DESCRIPTION
002	SEAL ASSEMBLY, OIL
003	BUSHING, PUMP BODY
094	RETAINER, FRONT HELIX SEAL
203	BODY, PUMP
204	RING, OIL SEAL (SLIDE TO WEAR PLATE)
205	SEAL, "O" RING (SLIDE SEAL BACK-UP)
206	SLIDE, PUMP
207	SPRING, PIVOT PIN
208	PIN, PIVOT SLIDE
209	SPRING, PUMP SLIDE (OUTER)
210	SUPPORT, PUMP SLIDE SEAL
211	SEAL, PUMP SLIDE
212	RING, PUMP VANE
213	GUIDE, ROTOR
214	ROTOR, OIL PUMP
215	VANE, PUMP
216	SHAFT, STATOR
217	COVER, PUMP
218	VALVE, PRESSURE REGULATOR
219	SPRING, PRESSURE REGULATOR VALVE
220	VALVE, REVERSE BOOST
221	SLEEVE, REVERSE BOOST VALVE
222	VALVE, T.V. BOOST
223	BUSHING, T.V. BOOST
224	RING, OIL PUMP REVERSE BOOST VALVE RETAINING
225	RING, OIL PUMP CONVERTER CLUTCH VALVE RETAINING
226	VALVE, STOP
227	VALVE, CONVERTER CLUTCH
228	SPRING, CONVERTER CLUTCH VALVE (OUTER)
229	SPRING, CONVERTER CLUTCH VALVE (INNER)
230	RIVET, PRESSURE RELIEF BOLT
231	BALL, PRESSURE RELIEF
232	SPRING, PRESSURE RELIEF
233	RING, OIL SEAL (STATOR SHAFT)
234	SEAL, OIL PUMP COVER SCREEN
235	SCREEN, OIL PUMP COVER
236	BOLT, M8 x 1.25 x 40 (COVER TO BODY)
237	PLUG, OIL PUMP AIR BLEED
238	PLUG, OIL PUMP COVER
239	PLUG, OIL PUMP COOLER FEED
240	PLUG, OIL PUMP CONVERTER CLUTCH SIGNAL
241	RETAINER & BALL ASSEMBLY, PUMP COVER
242	SCREW, STATOR SHAFT (M6 x 1 x 16.0)
243	SPRING, PUMP SLIDE (INNER)

49124F-700-R4

Figure 130 Oil Pump Assembly

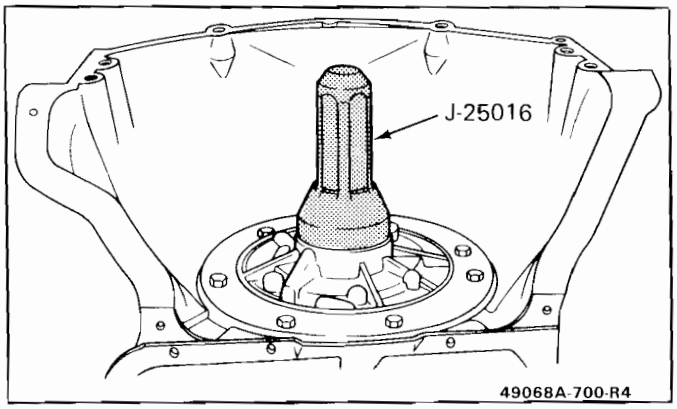


Figure 131 Oil Pump Seal

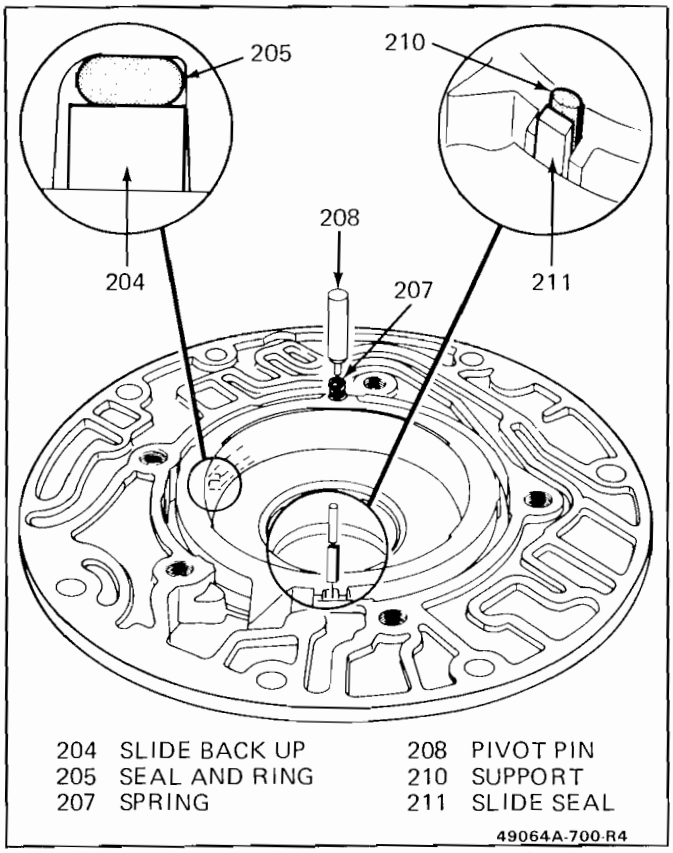


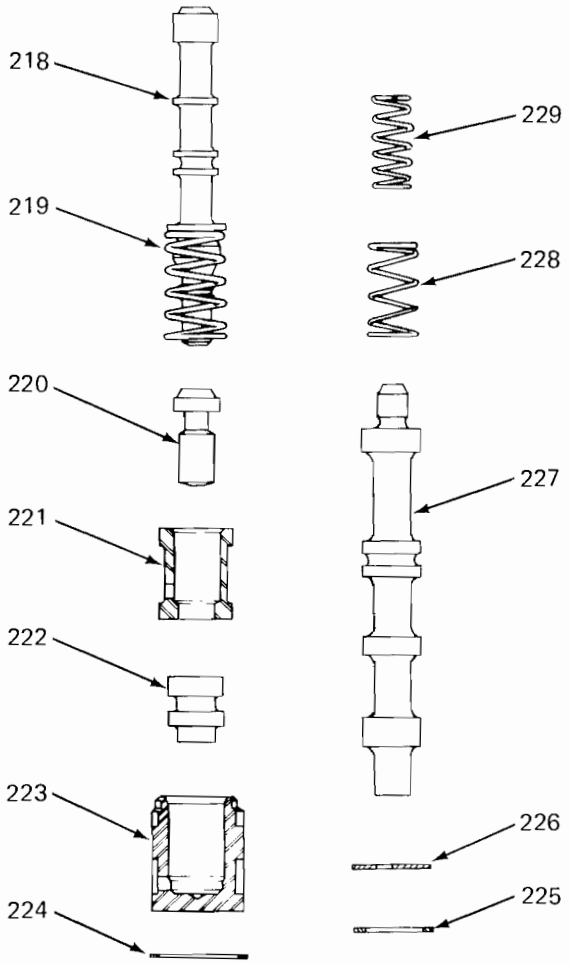
Figure 132 Slide Back Up and Slide Seal

- casting flash in the neck
- Solenoid assembly (50) for
  - damage
  - cut or pinched wires
  - damaged connectors
  - cut or damaged "O" ring (49)

Valve Body and Associated Parts

Install or Connect (Figure 145 and 146)

1. The 3-4 accumulator pin (77) into the case
2. The 3-4 accumulator piston seal (53) onto the 3-4 accumulator piston
3. The 3-4 accumulator piston (52) onto the pin
   - the end with three legs must face the valve body.



ILL. NO.	DESCRIPTION
218	VALVE, PRESSURE REGULATOR
219	SPRING, PRESSURE REGULATOR VALVE
220	VALVE, REVERSE BOOST
221	SLEEVE, REVERSE BOOST VALVE
222	VALVE, T.V. BOOST
223	BUSHING, T.V. BOOST
224	RING, OIL PUMP REVERSE BOOST VALVE RETAINING
225	RING, OIL PUMP CONVERTER CLUTCH VALVE RETAINING
226	STOP VALVE
227	VALVE, CONVERTER CLUTCH
228	SPRING, CONVERTER CLUTCH VALVE (OUTER)
229	SPRING, CONVERTER CLUTCH VALVE (INNER)

Figure 133 Pressure Regulator and Converter Clutch Apply Valve Trains

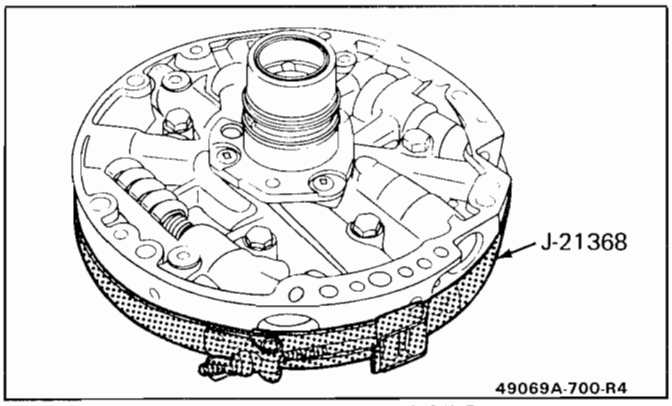


Figure 134 Assembly of Oil Pump

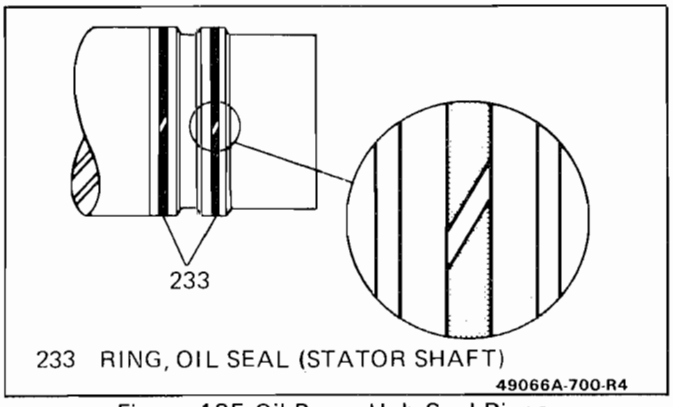


Figure 135 Oil Pump Hub Seal Rings

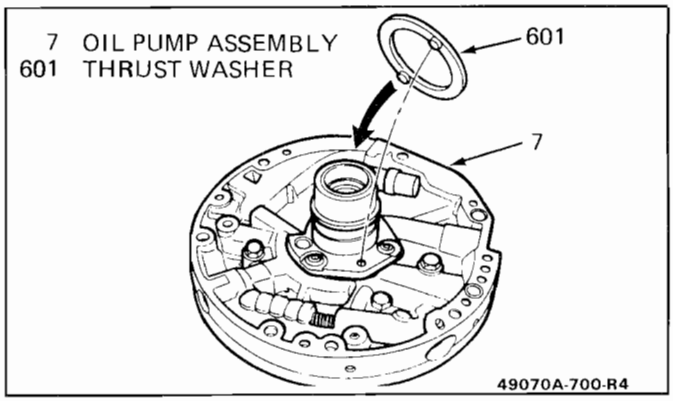


Figure 136 Oil Pump Thrust Washer

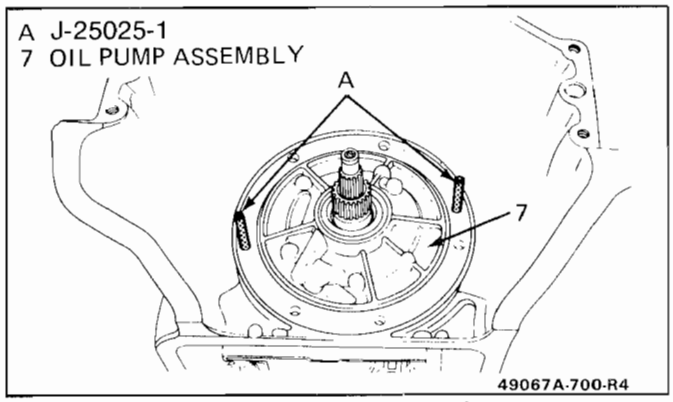


Figure 137 Oil Pump and Case

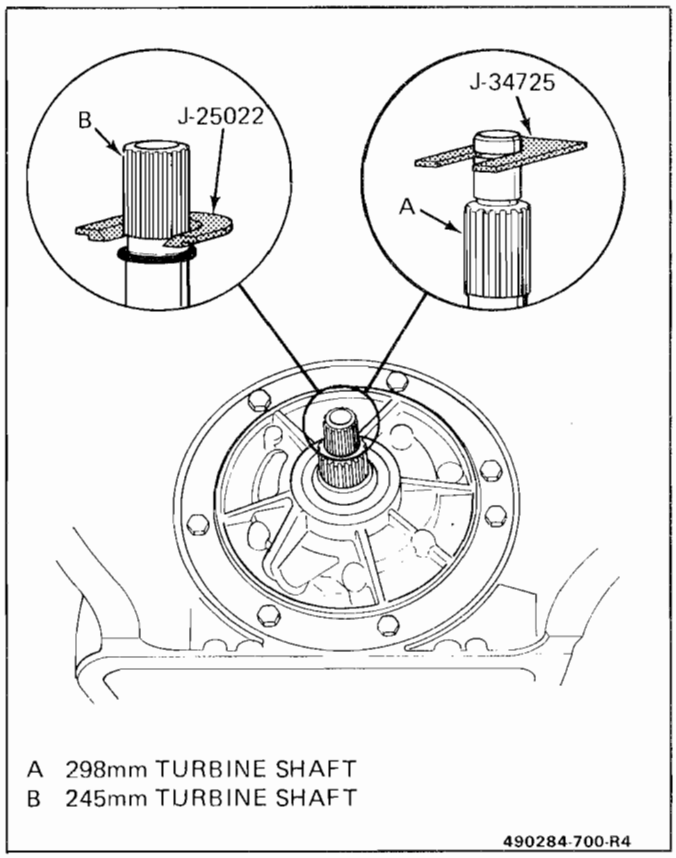


Figure 138 End Play Tool

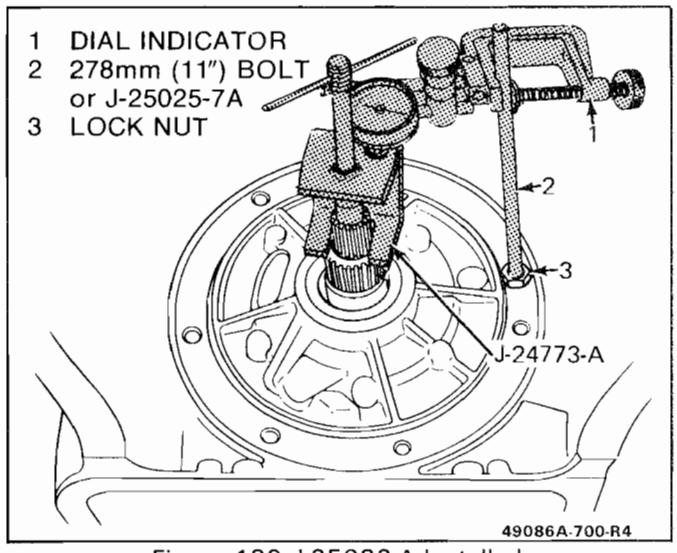


Figure 139 J-25022-A Installed

4. The 3-4 accumulator piston spring (54)

Install or Connect (Figures 147)

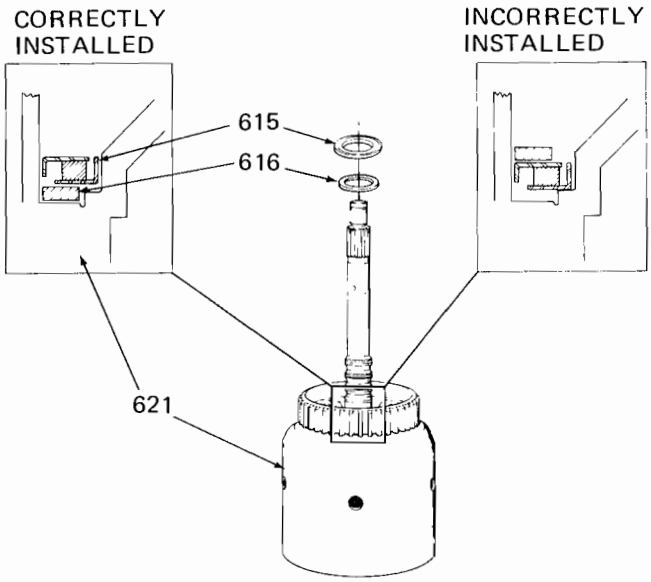
TOOLS REQUIRED:
J-25025-5 Guide Pins

1. Governor and converter clutch oil screens (47)
2. Five checkballs (55) into the case as shown
3. J-25025-5 into the case
4. Spacer plate to case gasket (88)
   - gasket identified by a "C"
5. Spacer plate (56)

TRANSMISSION END PLAY WASHER SELECTION CHART		
WASHER THICKNESS		I.D.
1.87 - 1.97 mm	(.074" - .078")	67
2.04 - 2.14 mm	(.080" - .084")	68
2.21 - 2.31 mm	(.087" - .091")	69
2.38 - 2.48 mm	(.094" - .098")	70
2.55 - 2.65 mm	(.100" - .104")	71
2.72 - 2.82 mm	(.107" - .111")	72
2.89 - 2.99 mm	(.113" - .118")	73
3.06 - 3.16 mm	(.120" - .124")	74

49047A-700-R4

Figure 140 End Play Chart



ILL. NO.	DESCRIPTION
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
621	HOUSING & SHAFT ASSEMBLY, INPUT

490279-700-R4

Figure 141 Selective Washer and Thrust Bearing Properly Installed

6. Valve body to spacer plate gasket (89)
   - gasket indentified by a "V"

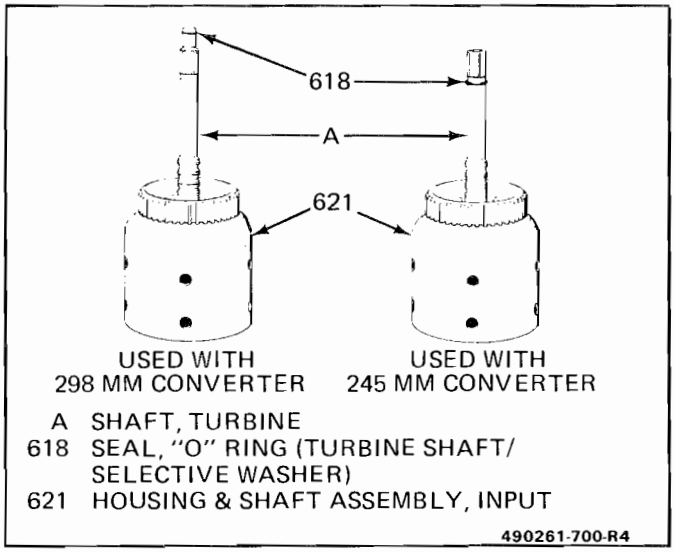
Control Valve Assembly

Clean

- Control valve assembly (67) thoroughly in clean solvent-move the valves with a pick or small screwdriver to dislodge any dirt or debris that may have accumulated
- Air Dry

Disassemble (Figures 148 & 149)

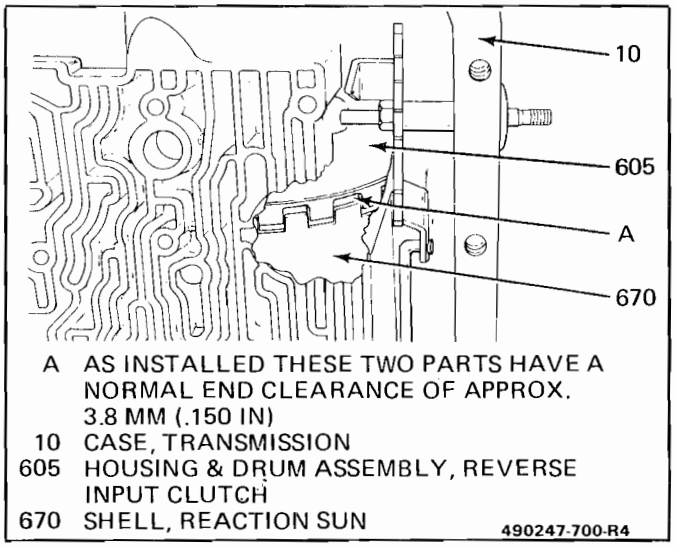
- Control Valve Assembly
  - –Position as shown on a clean surface



A	SHAFT, TURBINE
618	SEAL, "O" RING (TURBINE SHAFT/ SELECTIVE WASHER)
621	HOUSING & SHAFT ASSEMBLY, INPUT

490261-700-R4

Figure 142 Turbine Shaft "O" Ring Seal



A	AS INSTALLED THESE TWO PARTS HAVE A NORMAL END CLEARANCE OF APPROX. 3.8 MM (.150 IN)
10	CASE, TRANSMISSION
605	HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
670	SHELL, REACTION SUN

490247-700-R4

Figure 143 Clearance Between Reverse Input Clutch and the Sun Gear Shell

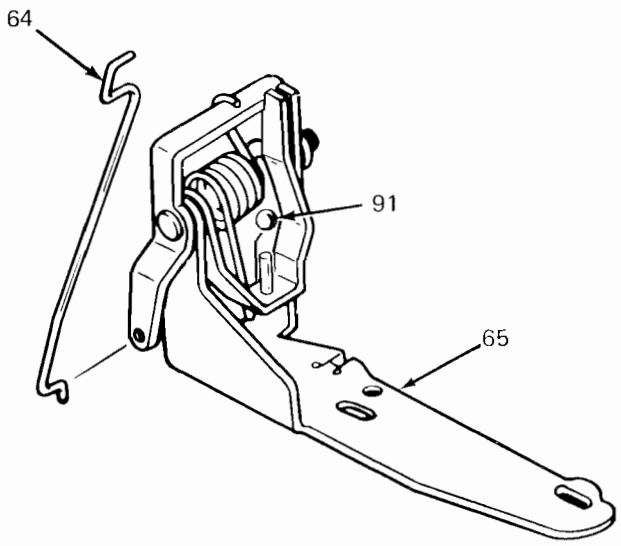
- Remove valve trains beginning with the upper left hand corner. **NOTE** : Some valves are under pressure - cover the bores while removing the roll pins
- Remove blind hole roll pins with a modified drill bit
- Valves, springs and bushings must be laid out on a clean surface in the exact sequence they are removed
- Remove pressure switches

Clean

- All valves, springs, bushings and control valve body in clean solvent
- Dry using compressed air

Inspect

- All Valves and Bushings For:
  - Porosity
  - Scoring
  - Nicks



64 THROTTLE LINK
65 LEVER & BRACKET ASSEMBLY, THROTTLE
91 BALL, CARBON STEEL – T.V. EXHAUST (LOCATED IN VALVE BODY)

49026C-700-R4

Figure 144 Throttle Lever and Bracket Assembly

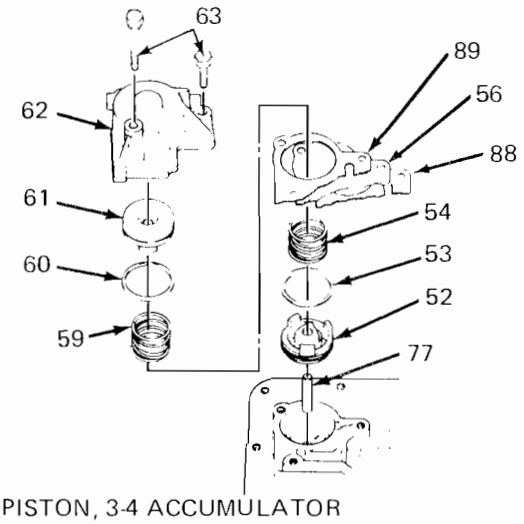
- Scratches
- Springs for Damaged or Distorted Coils
- Valve Body Casting For:
  - Porosity
  - Cracks
  - Interconnected Oil Passages
  - Damaged Machined Surfaces

Assemble (Figures 148, 149)

- Control valve assembly (67) exactly as shown. Notice the position of the valve lands and bushing passages.

Install or Connect (Figures 150, 151)

1. Three checkballs (55) and one checkball (91) into the valve body assembly as shown. Checkball (91) is the larger copper colored ball shown as #10 on Figure 150.
   - retain with petrolatum.
2. Valve body assembly (67)
   - connect the manual valve link (705) to the inside detent lever (703).



52 PISTON, 3-4 ACCUMULATOR
53 RING, OIL SEAL (3-4 ACCUMULATOR PISTON)
54 SPRING, 3-4 ACCUMULATOR
56 PLATE, VALVE BODY SPACER
59 SPRING, 1-2 ACCUMULATOR
60 RING, OIL SEAL (1-2 ACCUMULATOR PISTON)
61 PISTON, 1-2 ACCUMULATOR
62 COVER & PIN ASSEMBLY, 1-2 ACCUMULATOR
63 BOLTS, ACCUMULATOR COVER
77 PIN, ACCUMULATOR PISTON
88 GASKET, SPACER PLATE TO CASE
89 GASKET, SPACER PLATE TO VALVE BODY

49031B-700-R4

Figure 145 1-2 and 3-4 Accumulator Assembly

1987 MODELS	1-2 ACCUMULATOR SPRING COLOR	3-4 ACCUMULATOR SPRING COLOR
MHM, TNM, YNM, YPM, YSM, YWM, YZM	VIOLET	RED
TAM, TBM, TSM	RED	RED
YAM, YCM, YDM	RED	WHITE
ALL OTHER	DK. GREEN	RED

49248D-700-R4

Figure 146 1-2 and 3-4 Accumulator Spring Chart

Auxiliary Accumulator Valve Body Assembly

Clean

- Auxiliary valve assembly (377) thoroughly in clean solvent
  - move the valves with a pick or small screwdriver to dislodge any dirt or debris that may have accumulated
- Air dry

Disassemble (Figure 150A)

1. (3) Bolts (373)
   - Cover (371) is under spring pressure
2. Cover (371) and accumulator piston spring (370)
3. Piston (367)
4. Piston oil seal ring (53)

Disassemble (Figure 150A)

- Position the auxiliary accumulator valve body on a clean surface. Remove valve trains beginning with the lower left hand corner. NOTE; valves are under pressure-cover bores while removing the roll pin.
- Valves and springs must be laid out on a clean surface in the exact sequence as they are remvoed

Clean

- All valves and springs in clean solvent
- Air dry

Inspect

- Piston (367) for:
  - cracks
  - porosity
  - damage
- Valves for:
  - scoring
  - nicks
  - scratches
- Springs for damaged or distorted coils
- Auxiliary valve body (377) for:
  - porosity
  - damaged machined surfaces
- Orifice cup plug (359)
  - remove only if damaged

Remove or Disconnect

Tools Required
#3 Screw Extractor

- Orifice cup plug (359). Use modified #3 screw extractor

Install or Connect

Tools Required
3/8" Rod

- Orifice cup plug (359). Use 3/8" rod.
  - seat flush

Assemble (Figure 150A)

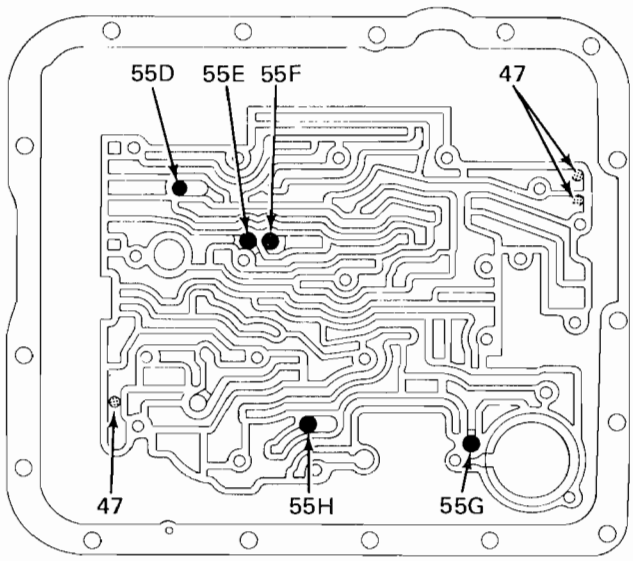
- Auxiliary accumulator valve train exactly as shown. Notice the valve lands

Assemble (Figure 150A)

1. Piston oil seal ring (053) onto piston (367)
   - lubricate with petrolatum
2. Piston (367)
3. Accumulator spring (370)
4. Cover (371) and (3) bolts (373)

Install or Connect (Figures 153 and 154)

1. Check ball (55) into auxiliary accumulator valve (377)
   - do not block orifice cup plug
   - retain with petrolatum
2. Bolts (374-376) and auxiliary valve body (377)
   - torque to 11 N·m (8 lbs.-ft.)



● CHECK BALL LOCATIONS ⊗ FILTER LOCATIONS

55D #9 CHECK BALL (DETENT/LO)
55E #4 CHECK BALL (3-4 CLUTCH/3-2 EX.)
55F #8 CHECK BALL (2ND/1-2)
55G #1 CHECK BALL (4TH ACCUMULATOR)
55H #3 CHECK BALL (PART THROTTLE/DRIVE 3)
47 GOVERNOR FILTER LOCATIONS
47 CONVERTER CLUTCH FILTER LOCATION

49243A-700-R4

Figure 147 Case Checkballs and Oil Screens - Location

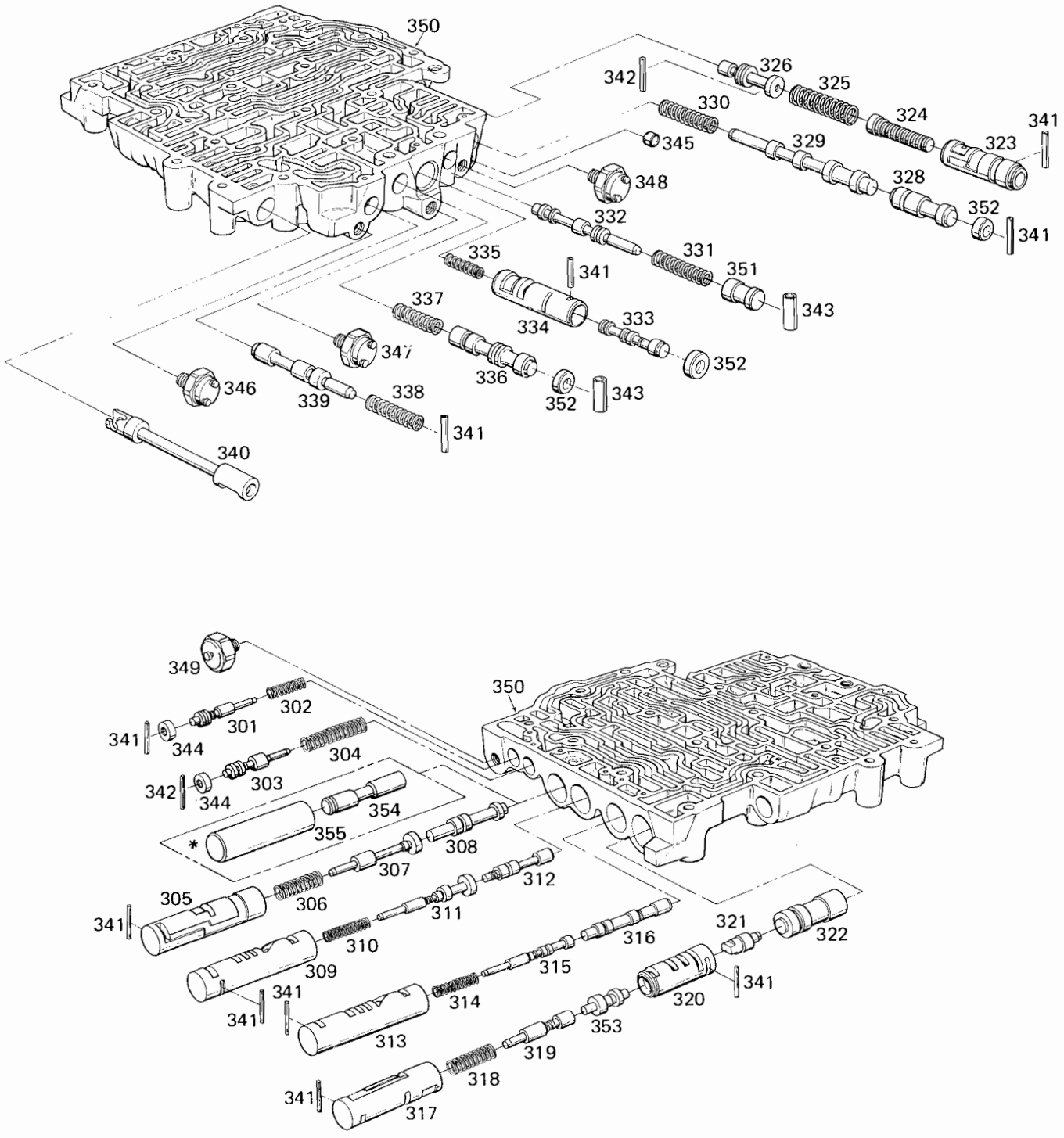
Inspect (Figure 144)

- The throttle lever and bracket assembly (65) for
  - sticking, binding or damage
- Make sure it operates freely without restrictions
- Replace if necessary

Install or Connect (Figures 152, 153 and 154)

1. T.V. link (64) onto the T.V. lever and bracket as shown
2. T.V. lever and bracket assembly (65) onto the valve body as shown
   - attach with two valve body to case bolts (69).
3. Wire harness clips (66), filter retaining clip (87), manual spring assembly (68), wire retaining washer, and all remaining valve body to case bolts (69)
   - Torque to 11.0 N·m (8 ft.lbs.).
4. "O"ring seal (34) onto the electrical connector (33)
   - lubricate with transmission fluid.
5. Electrical connector (33) into the case

BLANK



*USED ON VEHICLES HAVING ECM CONTROL OF T.C.C. APPLY

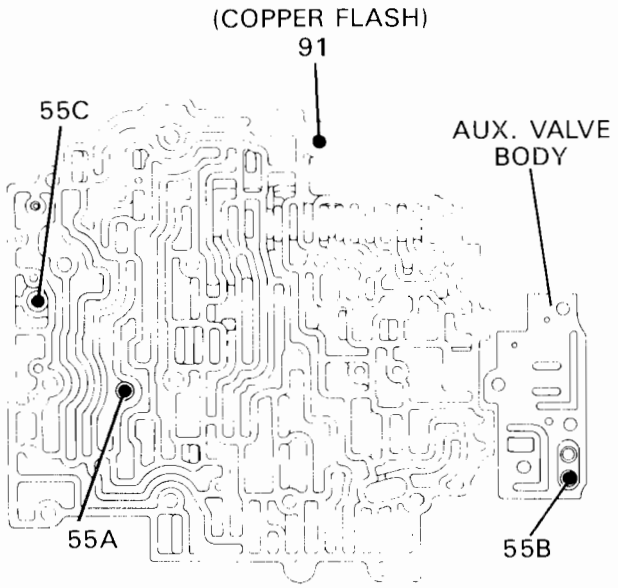
49212E-700-R4

Figure 148 Control Valve Assembly

ILL. NO.	DESCRIPTION
301	VALVE, T.V. MODULATOR DOWNSHIFT
302	SPRING, T.V. MODULATOR DOWNSHIFT VALVE
303	VALVE, T.V. MODULATOR UPSHIFT
304	SPRING, T.V. MODULATOR UPSHIFT VALVE
305	SLEEVE, CONVERTER CLUTCH THROTTLE
306	SPRING, CONVERTER CLUTCH THROTTLE
307	VALVE, CONVERTER CLUTCH THROTTLE
308	VALVE, CONVERTER CLUTCH SHIFT
309	SLEEVE, 3-4 THROTTLE VALVE
310	SPRING, 3-4 THROTTLE VALVE
311	VALVE, 3-4 THROTTLE
312	VALVE, 3-4 SHIFT
313	SLEEVE, 2-3 THROTTLE VALVE
314	SPRING, 2-3 THROTTLE VALVE
315	VALVE, 2-3 THROTTLE
316	VALVE, 2-3 SHIFT
317	SLEEVE, 1-2 THROTTLE VALVE
318	SPRING, 1-2 THROTTLE VALVE
319	VALVE, 1-2 THROTTLE
320	SLEEVE, LO RANGE CONTROL
321	VALVE, 1-2 LO RANGE DOWNSHIFT
322	VALVE, 1-2 SHIFT
323	SLEEVE, THROTTLE VALVE PLUNGER
324	PLUNGER, THROTTLE VALVE
325	SPRING, THROTTLE VALVE
326	VALVE, THROTTLE
328	VALVE, 3-4 RELAY
329	VALVE, 4-3 SEQUENCE
330	SPRING, 4-3 SEQUENCE VALVE
331	SPRING, T.V. LIMIT VALVE
332	VALVE, T.V. LIMIT
333	VALVE, 1-2 ACCUMULATOR
334	SLEEVE, 1-2 ACCUMULATOR VALVE
335	SPRING, 1-2 ACCUMULATOR VALVE
336	VALVE, LINE BIAS
337	SPRING, LINE BIAS VALVE
338	SPRING, 3-2 CONTROL
339	VALVE, 3-2 CONTROL
340	VALVE, MANUAL
341	PIN, COILED SPRING
342	PIN, COILED SPRING
343	RETAINER, SPRING (SLEEVE)
344	PLUG, VALVE BORE
345	PLUG, CUP (.33 DIA.)
346	SWITCH ASM., PRESSURE (3RD CLUTCH)
347	SWITCH ASM., PRESSURE (4-3 PULSE)
348	SWITCH ASM., PRESSURE (4TH CLUTCH)
349	SWITCH ASM., PRESSURE (T.C.C. SIGNAL)
350	BODY, CONTROL VALVE
351	PLUG, T.V. LIMIT
352	PLUG, VALVE BORE (12.5 - O.D.)
353	VALVE, 1-2 LO RANGE UPSHIFT
354	PLUG, CONVERTER CLUTCH SHIFT VALVE BORE (ECM CONTROLLED VEHICLES)
355	PLUG, CONVERTER CLUTCH T.V. BUSHING BORE (ECM CONTROLLED VEHICLES)

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Figure 149 Control Valve Assembly-Legend



55A #2 CHECKBALL (3RD CLUTCH ACCUM.)
55B #5 CHECKBALL (FORWARD CLUTCH)
55C #6 CHECKBALL (DRIVE 3)
91 #10 CHECKBALL (T.V. EXHAUST)

49002D-700-R4

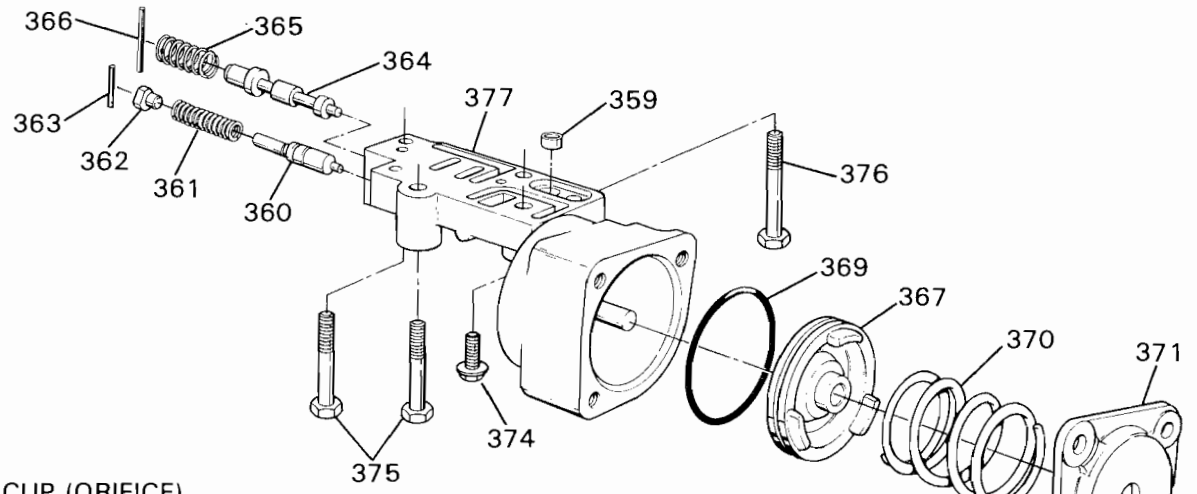
Figure 150 Valve Body Checkball Locations

6. "O" ring seal (49) on the solenoid assembly (50)
7. Solenoid assembly (50) into the case
   - attach with two solenoid bolts (51)
   - torque to 11 N·m (8 ft. lbs.)
   - to correctly route and hook up the wires see the wiring diagrams in the 700-R4 diagnosis section.

     The wire connectors are color coded to correspond to the information in the wiring diagram. On switches which take two connectors, the terminals are reversible. It will be necessary to identify and use the wiring diagram chart which corresponds to the type of vehicle you are working on. (See the Diagnosis Section for the wiring diagrams.)

Install or Connect (Figures 145, 152, and 153)

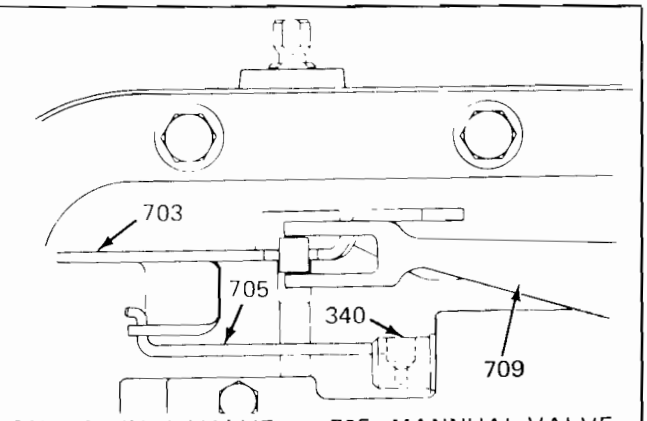
1. Parking bracket (710)
   - torque to 22 N·m (18 ft. lbs.)
2. Oil passage cover (79) and bolts (78)
   - torque to 11 N·m (8 ft. lbs.)
3. The 1-2 accumulator piston seal (60) onto the 1-2 accumulator piston ((61)
4. The 1-2 accumulator piston (61) into the 1-2 accumulator cover and pin assembly (62)
   - the three legs on the piston must face up toward the case when installed.
5. The 1-2 accumulator spring (59) onto the piston
6. The 1-2 accumulator cover and pin assembly (62) onto the case



359 PLUG, CUP (ORIFICE)
360 VALVE, ABUSE
361 SPRING, ABUSE VALVE
362 STOP, ABUSE VALVE
363 PIN, SPRING
364 VALVE, LO OVERRUN CLUTCH
365 SPRING, LO OVERRUN CLUTCH VALVE
366 PIN, SPRING VALVE RETAINING
367 PISTON, ACCUMULATOR
369 RING, OIL SEAL ACCUMULATOR PISTON
370 SPRING, ACCUMULATOR PISTON
371 COVER, AUXILIARY ACCUMULATOR VALVE
373 BOLT, SPEC. HEX WASHER HEAD (M6 X 1 X 24)
374 BOLT, SPEC. HEX WASHER HEAD (M6 X 1 X 16)
375 BOLT, HEX HEAD (M6 X 1 X 40)
376 BOLT, HEX HEAD (M6 X 1 X 45)
377 AUXILIARY ACCUM. VALVE BODY ASM.

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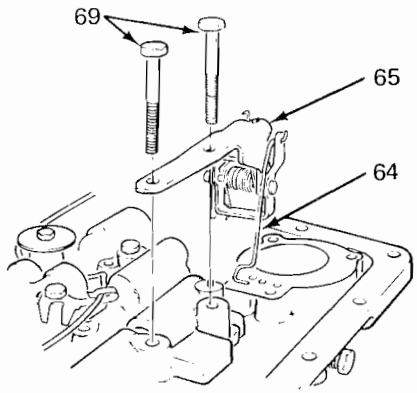
Figure 150A Auxiliary Valve Body Assembly



340 MANUAL VALVE
703 INNER DETENT LEVER
705 MANNUAL VALVE LINK
709 MANUAL DETENT SPRING ASSEMBLY

49082D-700-R4

Figure 151 Manual Valve Link



64 LINK, THROTTLE LEVER TO CABLE
65 LEVER & BRACKET ASSEMBLY, THROTTLE
69 BOLTS, CONTROL VALVE ASSEMBLY

49249A-700-R4

Figure 152 T.V. Lever and Bracket

- torque to 11 N·m (8 ft. lbs.)

Install or Connect (Figure 155)

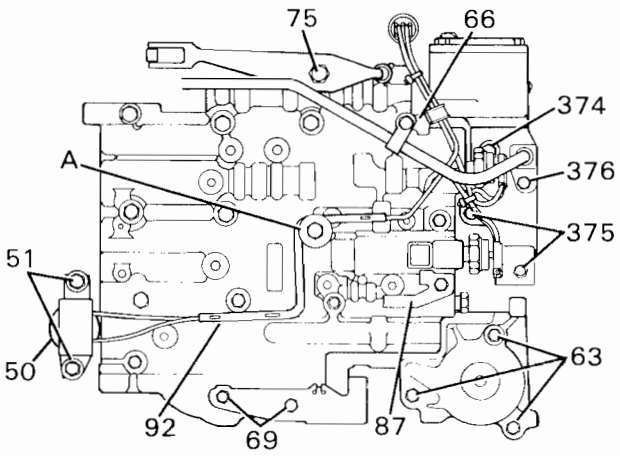
1. "O" ring seal (70) onto the oil filter
   - lubricate with transmission fluid.
2. Oil filter (71)
3. Oil pan gasket (72)
4. Chip magnet (93) into oil pan (73)
5. Oil pan (73) and bolts (74)
   - torque to 16 N·m (12 ft. lbs.)

2-4 Servo Assembly

Measure (Figure 156)

TOOLS REQUIRED:
J-33037 Band Apply Pin Tool

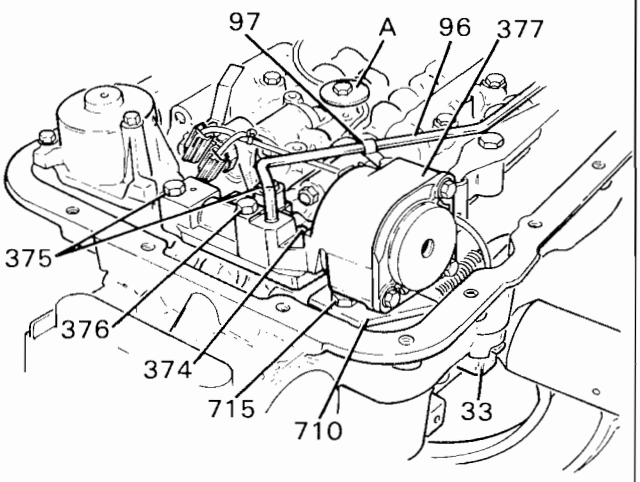
1. Install J-33037 as shown with apply pin (29).
2. Apply 11.0 N·m (100 in. lbs.) torque.
3. If white line "A" appears in the gage slot "B", pin length is correct.
4. Use pin selection chart to determine the correct pin length.



A WASHER WIRE RETAINER
50 SOLENOID ASSEMBLY
51 BOLT, HEX WASHER HEAD (SOLENOID)
63 BOLT, ACCUMULATOR COVER
66 CLIP, ELECTRICAL WIRE
69 BOLT, VALVE BODY
75 BOLT, MANUAL DETENT SPRING
87 CLIP, FILTER RETAINER
92 CONDUIT, SOLENOID WIRE
374 BOLT, SPEC. HEX WASHER HEAD (M6 X 1 X 16)
375 BOLT, HEX HEAD (M6 X 1 X 35)
376 BOLT, HEX HEAD (M6 X 1 X 45)

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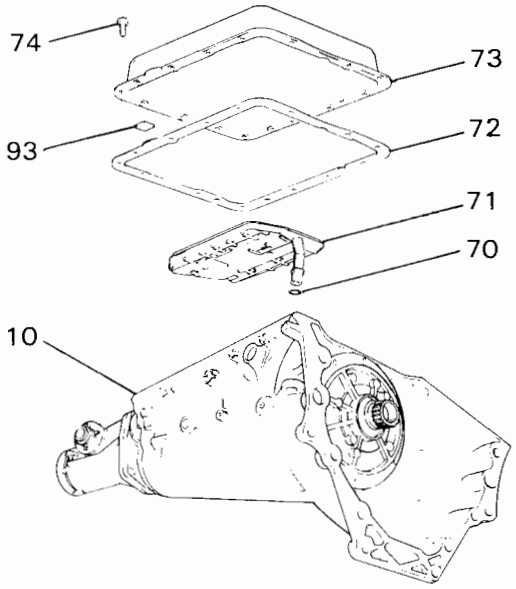
Figure 153 Valve Body Bolt Locations



A WASHER, WIRE RETAINING
33 CONNECTOR, ELECTRICAL
96 TUBE, AUXILIARY ACCUMULATOR VALVE
97 CLAMP, TUBE
374 BOLT, SPECIAL HEX HEAD (M6 X 1 X 16)
375 BOLT, HEX HEAD (M6 X 1 X 35)
376 BOLT, HEX HEAD (M6 X 1 X 45)
377 AUXILIARY ACCUM. VALVE BODY ASM.
710 BRACKET, PARKING LOCK
715 BOLT, PARKING LOCK BRACKET

49239A-700-R4

Figure 154 Outside Electrical Connector



10 CASE, TRANSMISSION
70 SEAL, "O" RING (FILTER)
71 FILTER ASSEMBLY, TRANSMISSION OIL
72 GASKET, TRANSMISSION OIL PAN
73 PAN, TRANSMISSION OIL
74 SCREW, SPEC. HEX WASHER HEAD (PAN)
93 MAGNET, CHIP COLLECTOR

49323A-700-R4

490323-700-R4

Figure 155 Case, Pan and Filter Assembly

Inspect

- Pistons for
  - porosity or damage
  - ring groove damage
- Cover (15) for porosity or damage
- Seals for
  - nicks or cuts
  - freeness in the seal groove
- Springs for distortion
- Pin for wear or burrs

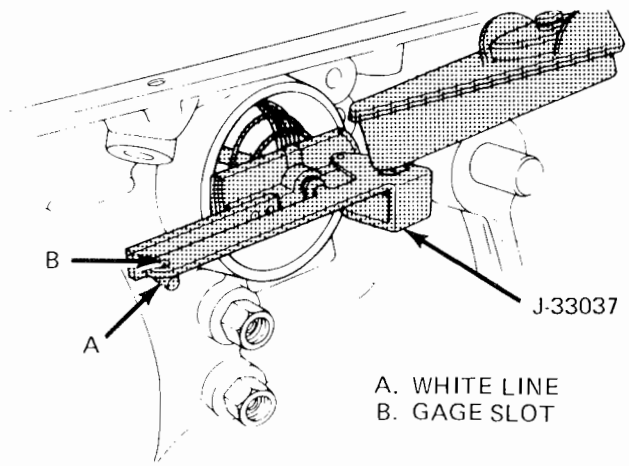
Important

Check servo bore in the case for any wear or sharp edges which may cut the servo seals.

Measure (Figure 157)

TOOLS REQUIRED:
Vernier Calipers
Scale

1. Measure Piston (25) Dimension *A



PIN IS PRESET AT FACTORY AND MUST NOT BE READJUSTED

2-4 SERVO PIN SELECTION

PIN LENGTH		PIN I.D.
mm	INCH	
66.37-66.67	2.61-2.62	2 RINGS
67.74-68.04	2.67-2.68	3 RINGS
69.11-69.41	2.72-2.73	WIDE BAND

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Figure 156 Servo Pin Length

2. Measure housing (22) Dimension **B
3. Check Model Application

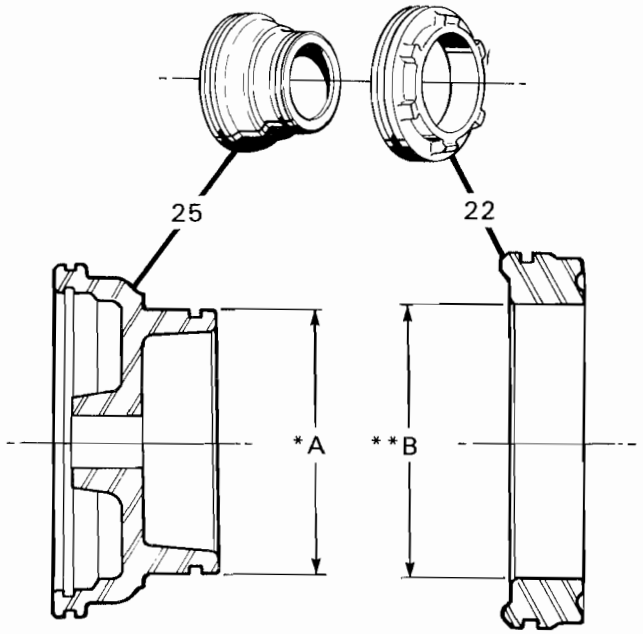
Assemble (Figures 158, 159, 160 and 161)

TOOLS REQUIRED:
J-22269-01
J-29714

1. Cushion spring (26) into the 2nd apply piston (25)
2. Cushion spring retainer (27) on the cushion spring
3. Install J-22269-01.
   - compress the retainer past the snap ring groove in the 2nd apply piston.
   - install the retainer ring (28).
4. The 2nd apply piston (25) onto the apply pin (29)
   - retainer goes toward the shoulder of the pin.
5. Servo apply pin spring (20) on the pin
6. Servo apply pin washer (19) and retaining clip (18)
7. Inner (23) and outer (24) seals on the 2nd apply piston
   - retain with petrolatum.
8. Apply pin seals (30) on the apply pin
   - retain with petrolatum.
9. "O" ring seal (21) on servo piston housing
10. Servo piston inner housing (22) on the 2nd apply piston
11. Seal ring (17) onto the 4th apply piston
12. The 4th apply piston (16) onto the apply pin
13. Return spring (31) on the pin

2ND APPLY PISTON & HOUSING APPLICATION

MODEL	PISTON DIMENSION *A	HOUSING DIMENSION **B
YAM, YCM, YDM, YMM	44.64 mm (1.78")	45.54 mm (1.79")
MHM, MPM, MWM, MZM, PAM, PBM, PCM, TNM, TRM, TUM, TXM, YKM, YNM, YPM, YSM, YWM, YZM	57.85 mm (2.28")	58.74 mm (2.31")
ALL OTHERS	63.10 mm (2.48")	64.00 mm (2.52")



22 HOUSING, SERVO PISTON (INNER)
25 PISTON, 2ND APPLY

49287C-700-R4

Figure 157 2nd Apply Piston and Housing Measurement

14. Servo piston assembly into the servo bore
15. "O" ring seal (14) on the servo cover
    - lubricate the seal with transmission fluid.
16. Servo cover (15) into the servo bore
17. Install J-29714.
    - compress the servo cover.
    - install the retainer ring (13)

Governor Assembly (45)

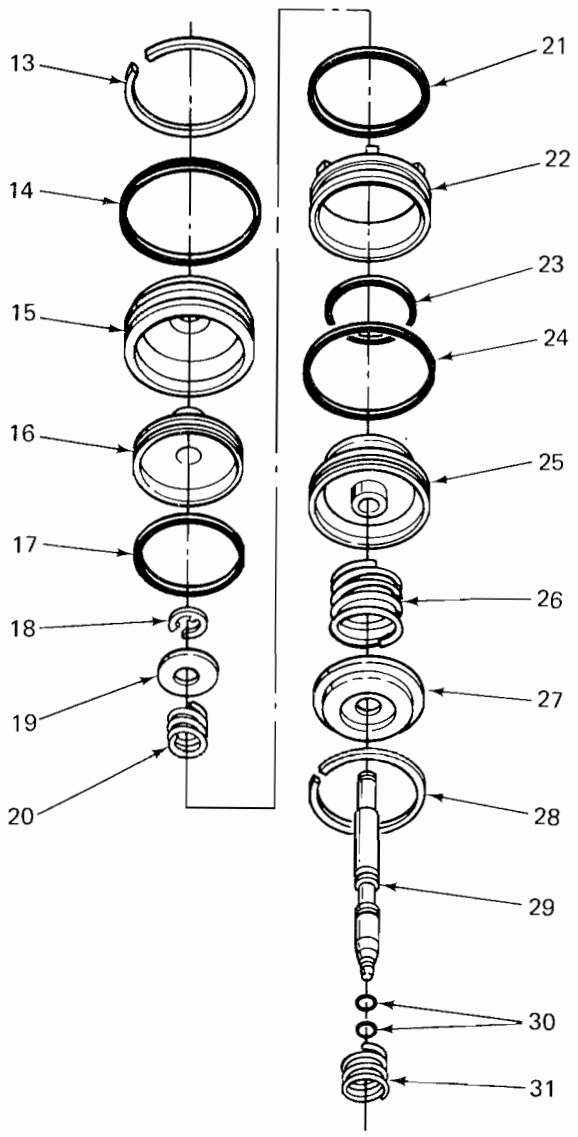
Inspect (Figure 162)

- Valve for free operation
- Weights for free operation
- Springs - missing or distorted
- Sleeve for nicks, burrs, scored or galled
- Driven gear for damage

Disassemble

DO NOT DISASSEMBLE EXCEPT, FOR CLEANING OR PART REPLACEMENT.

1. Cut off one end of each governor weight pin.



13 RING, SERVO COVER RETAINING
14 SEAL, "O" RING (2-4, SERVO COVER)
15 COVER, 2-4 SERVO
16 PISTON, 4TH APPLY
17 RING, OIL SEAL OUTER (4TH APPLY PISTON)
18 RING, RETAINER (APPLY PIN)
19 WASHER, SERVO APPLY PIN
20 SPRING, SERVO APPLY PIN
21 SEAL, "O" RING
22 HOUSING, SERVO PISTON INNER
23 RING, OIL SEAL INNER (2ND APPLY PISTON)
24 RING, OIL SEAL OUTER (2ND APPLY PISTON)
25 PISTON, 2ND APPLY
26 SPRING, SERVO CUSHION
27 RETAINER, SERVO CUSHION SPRING
28 RING, RETAINER (2ND APPLY PISTON)
29 PIN, 2ND APPLY PISTON
30 SEAL, 2ND APPLY PISTON PIN
31 SPRING, SERVO RETURN

Figure 158 2-4 Servo Assembly

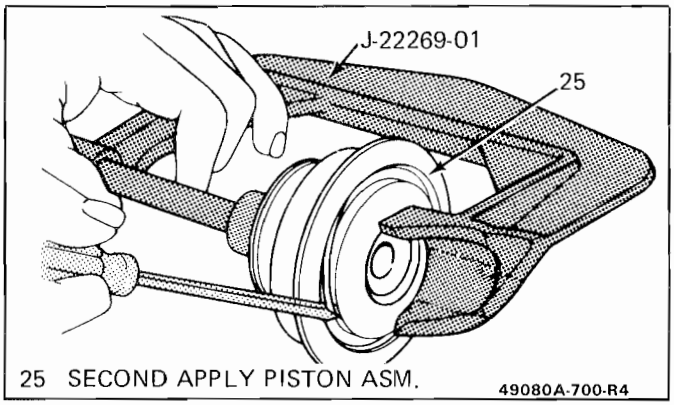


Figure 159 2nd Servo Piston - Assembly

2. Pins (84)
3. Weights
4. Valve
5. Driven gear (83)
   - Drive out the retainer pin (82) with a small punch.
   - Support the governor assembly sleeve on plates installed in the exhaust slots. Push out the gear with an arbor press and a long punch.

Clean

- Wash all parts in solvent.
- Air dry and blow out passages.

Assemble

1. Install a new governor drive gear.
   - support the governor or plates through the exhaust slots.
   - press gear (83) into the sleeve until seated.
   - drill a new retaining pin hole in the sleeve ninety degrees from the existing hole. Use a 3.0 mm (1/8 in.) drill.
   - Install retainer pin (82) and stake.
2. Valve into the sleeve
3. Weights, springs, and thrust cap onto the governor assembly
4. Retaining pins (84) into the thrust cap (85) and governor assembly
5. Stake the retaining pins (84).
6. Check for free operation of the valve and weights.

B (Figures 162, 163)

1. Governor assembly (45) into the governor bore
2. Governor Cover (46)
   - apply sealant, such as loctite cup plug sealant #11 or equivalent to cover flange before installation.

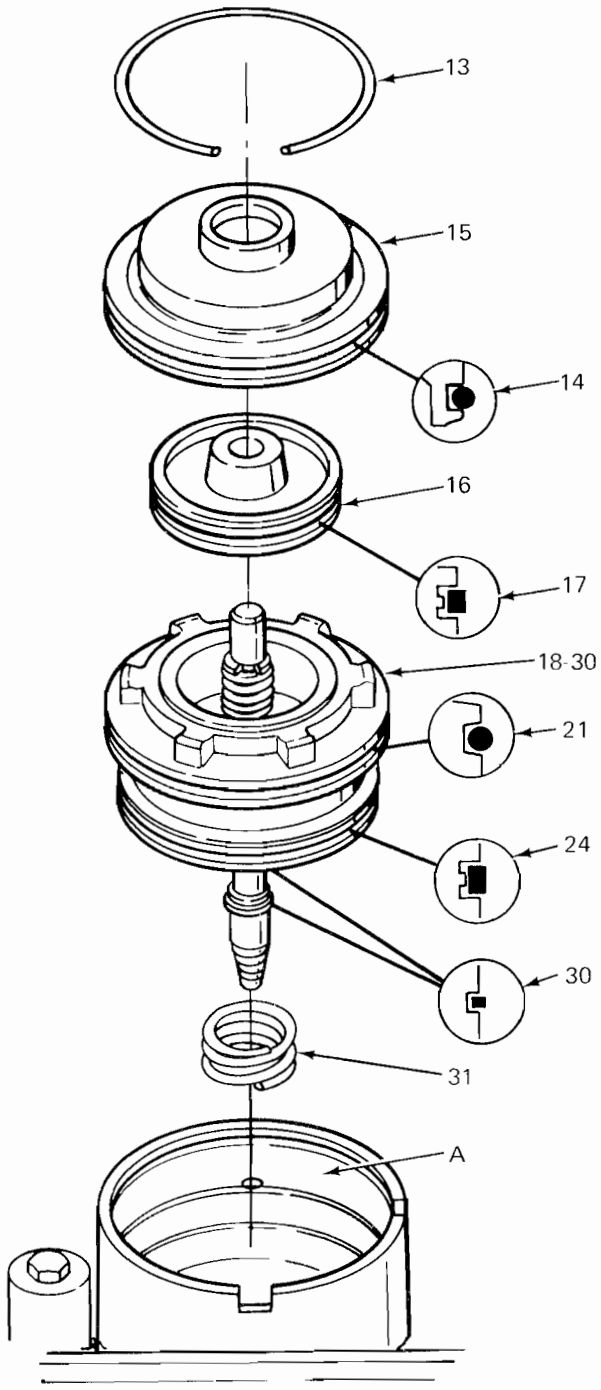
Install or Connect (Figures 164 thru 169)

MECHANICAL SPEEDOMETER

TOOLS REQUIRED:

J-23103 or J-25016 Seal Installer
J-21426 Seal Installer

1. Speedometer drive gear (689) and clip (688)



A CASE SERVO BORE
13 RING, SERVO COVER RETAINING
14 SEAL, "O" RING (2-4 SERVO COVER)
15 COVER, 2-4 SERVO
16 PISTON, 4TH APPLY
17 RING, OIL SEAL OUTER (4TH APPLY PISTON)
18-30 2ND APPLY PISTON ASSEMBLY
21 SEAL, "O" RING
24 RING, OIL SEAL OUTER (2ND APPLY PISTON)
30 SEAL, 2ND APPLY PISTON PIN
31 SPRING, SERVO RETURN

Figure 160 2-4 Servo Bore

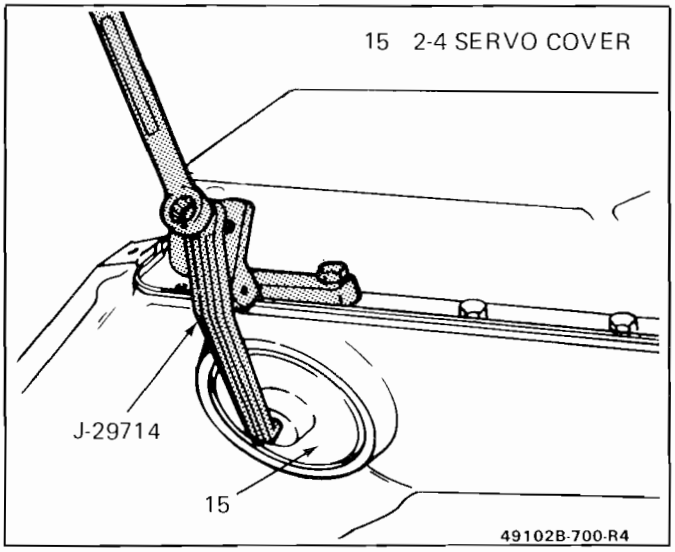


Figure 161 Servo Cover - Installed

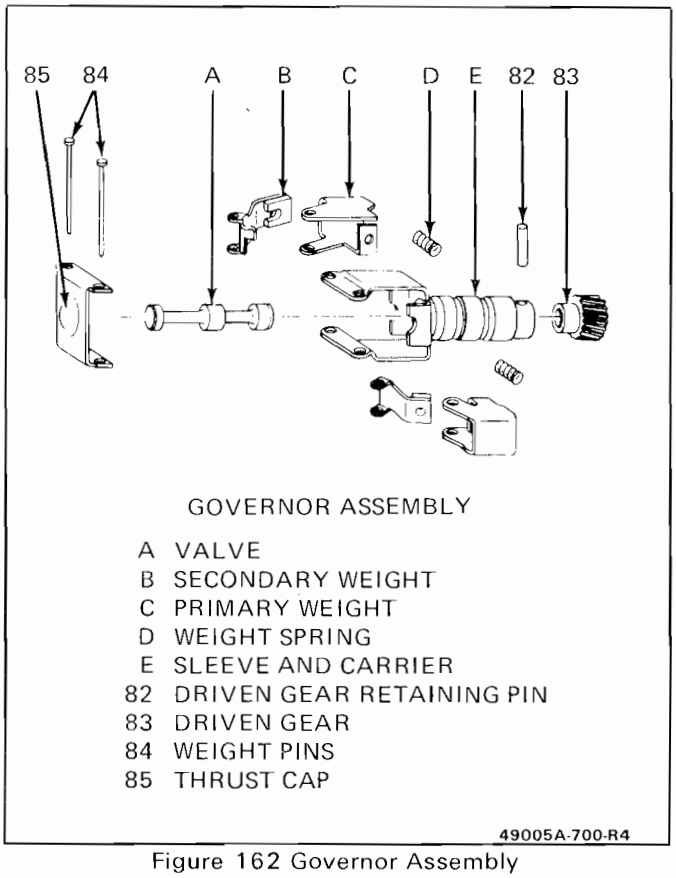
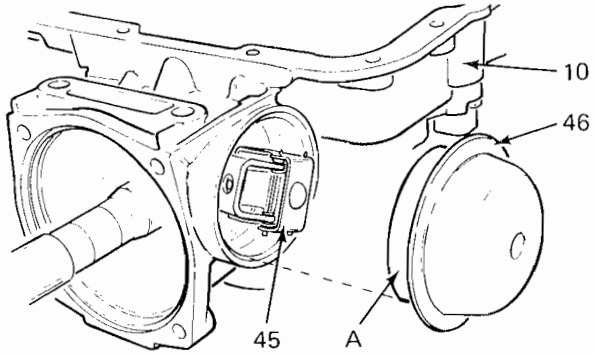


Figure 162 Governor Assembly

- if the output shaft has two speedometer locating holes, use the hole nearest the yoke spline for Corvette vehicles only.

2. "O" ring seal (691) on the output shaft sleeve
3. Output shaft sleeve (690) on the output shaft



A APPLY SEALANT ON THIS FLANGE BEFORE INSTALLATION
10 CASE, TRANSMISSION
45 GOVERNOR ASSEMBLY
46 COVER, GOVERNOR

Figure 163 Governor Cover

- use J-25016 or J-23103.
- do not push the sleeve past the machined surface on the output shaft.

4. Seal ring (35) on the case extension
5. Case extension (36) and bolts (37) or, stud (100) and nut (98)
   - position extension so the speedometer bore is on the governor side of the case.
   - torque to 35 N·m (26 ft. lbs.)
6. Remove case extension oil seal (89)
   - pry out with a screwdriver
   - install new seal with J-21426
7. Speedometer driven gear (44) and assembly (43) or speed sensor (99)
8. Retainer (40) bolt and washer (41)
9. Outside electrical connector, manual lever and nut

Torque Converter Assembly

Inspect

The torque converter assembly (1) must be replaced for any of the following conditions:

- Evidence of damage to the pump assembly
- Metal particles are found after flushing the cooler and cooler pipes
- External leaks in hub weld area
- Converter pilot is broken, damaged or poor fit into crankshaft
- Converter hub is scored or damaged
- Internal damage to stator
- Contamination from engine coolant
- Excess end play

Measure (Figure 172)

Tool Required:
J-35138 Torque Converter End Play Checking Tool

- Install J-35138 and measure end play
  - 0mm - .5mm (.020") for 245mm Torque Converters
  - 0mm - .6mm (.024") for 298mm Torque Converters

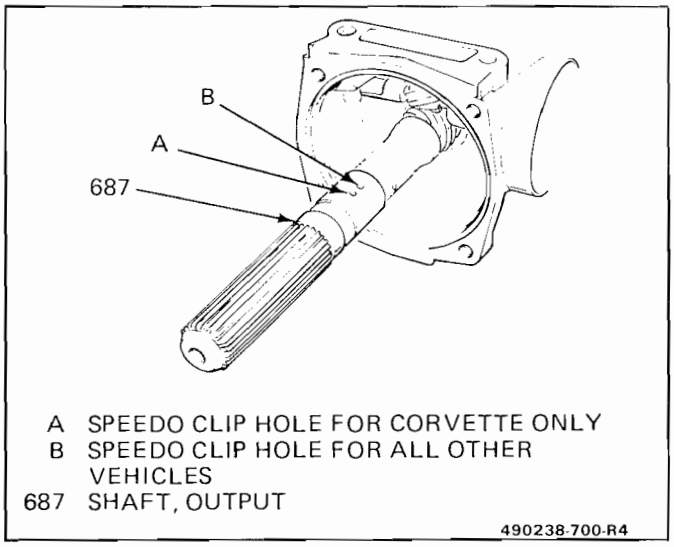
The Torque Converter Should Not Be Replaced If:

- The fluid has an odor, discolored or no evidence of metal or clutch plate material
  - Drain out as much fluid as possible
  - Replace the oil filter and pan gasket
  - Fill to proper level (Refer to Section 7A)
- The converter bolt hole threads are damaged
  - Correct with thread insert (Refer to Section 6A)

Flushing the torque converter is not recommended.

Install or Connect

1. Torque converter (1)
2. J-21366 converter holding strap
3. Remove transmission from holding fixture



A SPEEDO CLIP HOLE FOR CORVETTE ONLY
B SPEEDO CLIP HOLE FOR ALL OTHER VEHICLES
687 SHAFT, OUTPUT

Figure 164 Speedo. Clip Holes

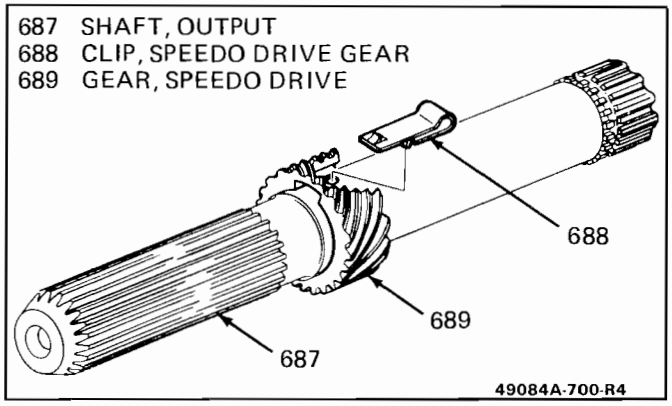


Figure 165 Speedometer Gear

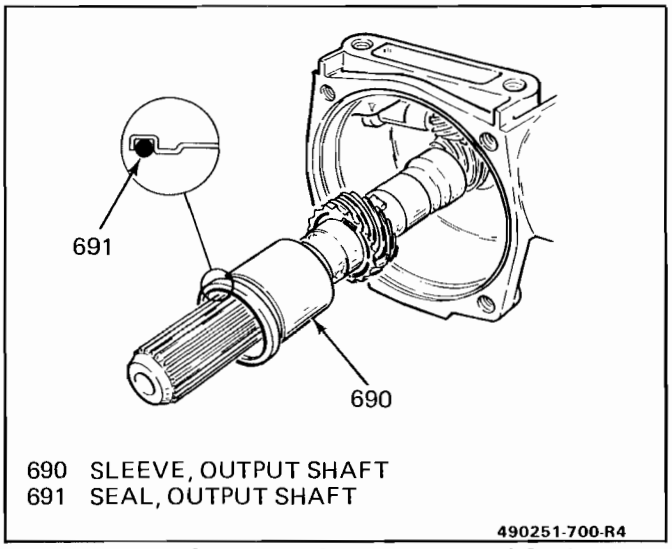


Figure 167 Output Shaft Sleeve and Seal

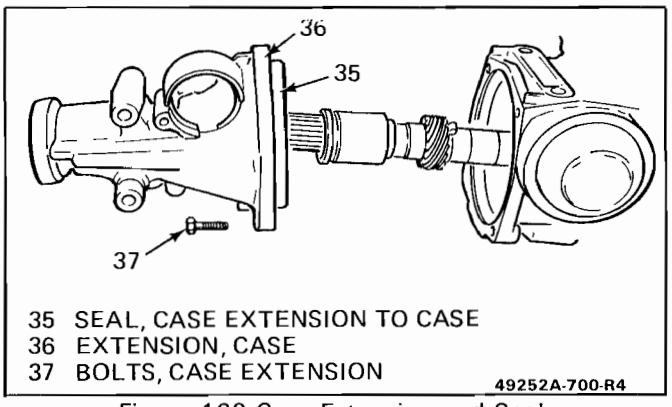


Figure 169 Case Extension and Seal

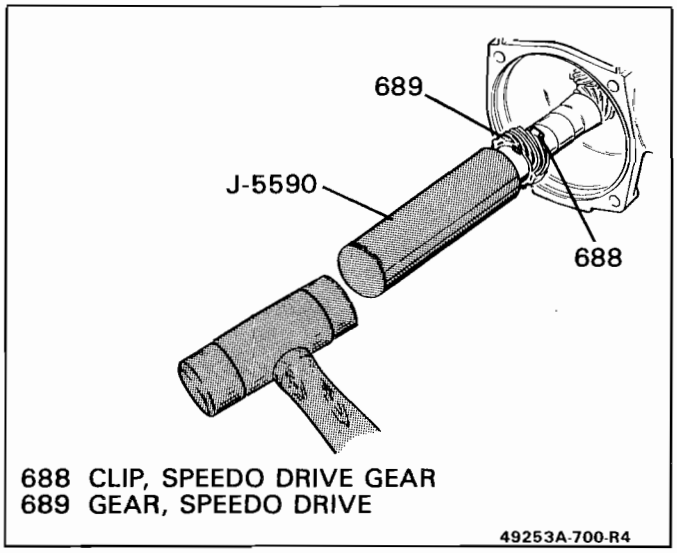


Figure 166 Speedo. Gear - Installation

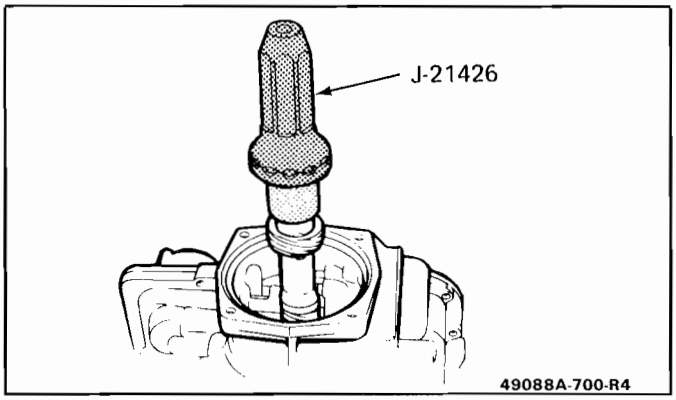
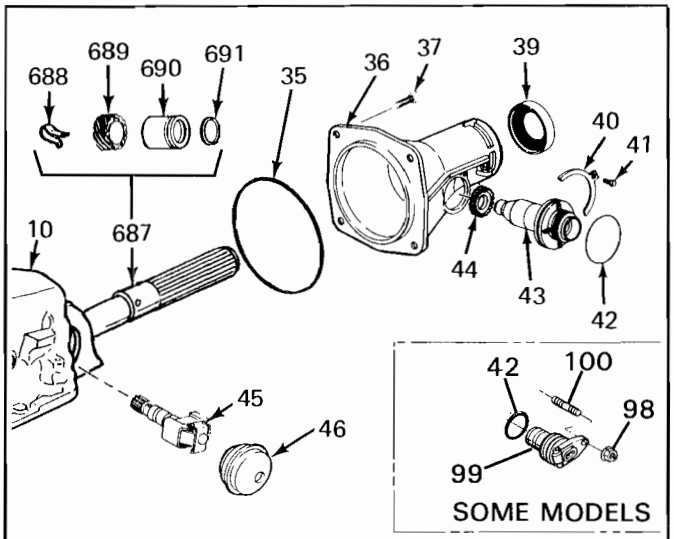


Figure 168 Output Shaft Sleeve - Installation



10 CASE, TRANSMISSION
35 SEAL, CASE EXTENSION TO CASE
36 EXTENSION, CASE
37 BOLT, CASE EXTENSION TO CASE
39 SEAL ASSEMBLY, CASE EXTENSION OIL
40 RETAINER, SPEEDO DRIVEN GEAR FITTING
41 BOLT & WASHER ASSEMBLY
42 SEAL, "O" RING (SPEEDO FITTING TO CASE EXTENSION)
43 FITTING ASSEMBLY, SPEEDO DRIVEN GEAR
44 GEAR, SPEEDO DRIVEN
45 GOVERNOR ASSEMBLY
46 COVER, GOVERNOR
98 NUT, FLANGED HEX
99 SPEED SENSOR, INTERNAL TRANSMISSION
100 STUD, DOUBLE END
687 SHAFT, OUTPUT
688 CLIP, SPEEDO DRIVE GEAR
689 GEAR, SPEEDO DRIVE
690 SLEEVE, OUTPUT SHAFT — NOT USED ON
691 SEAL, OUTPUT SHAFT — ALL MODELS

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Figure 170 Case Extension and Associated Parts

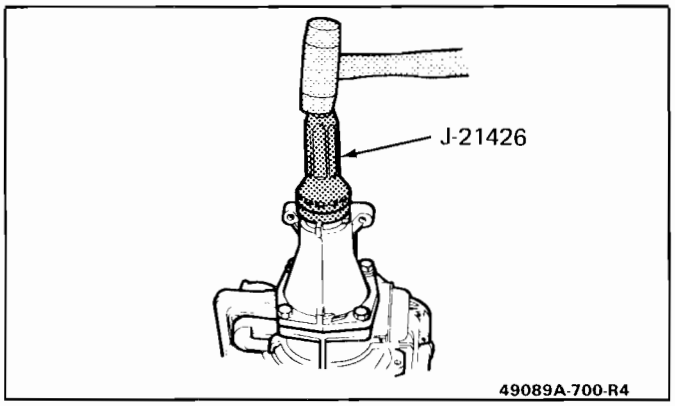


Figure 171 Case Extension Oil Seal Assembly

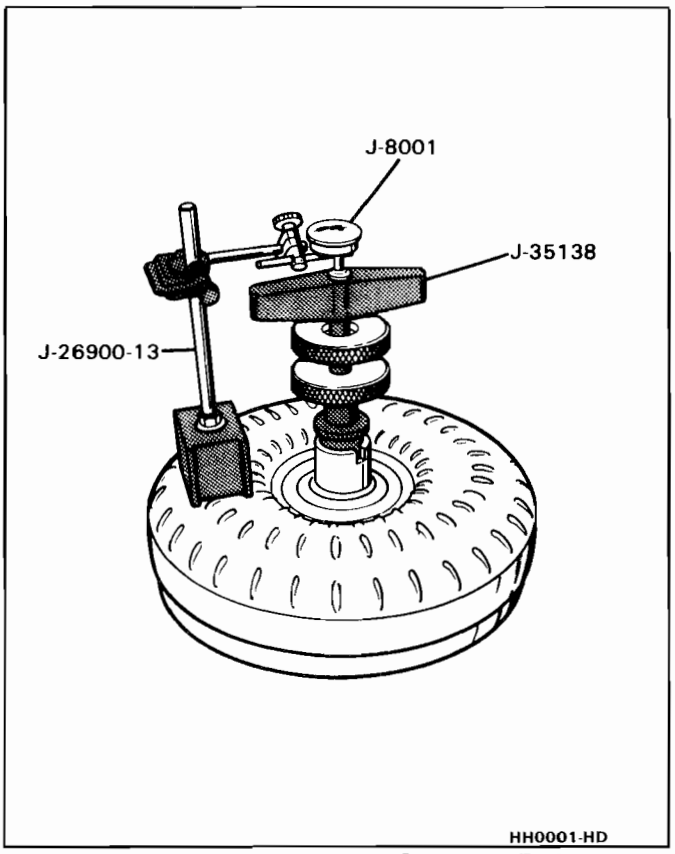
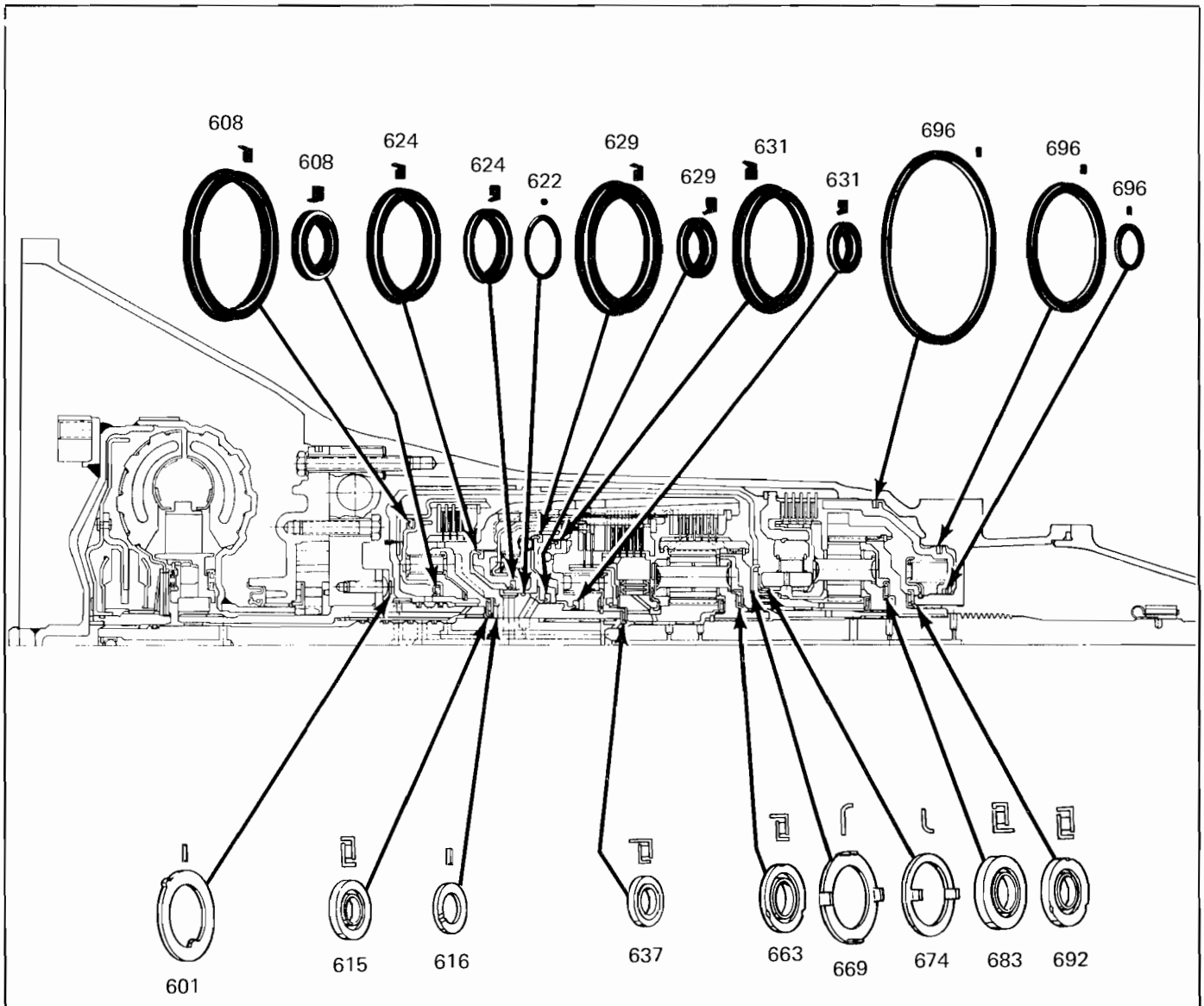


Figure 172 Checking Torque Converter End Play

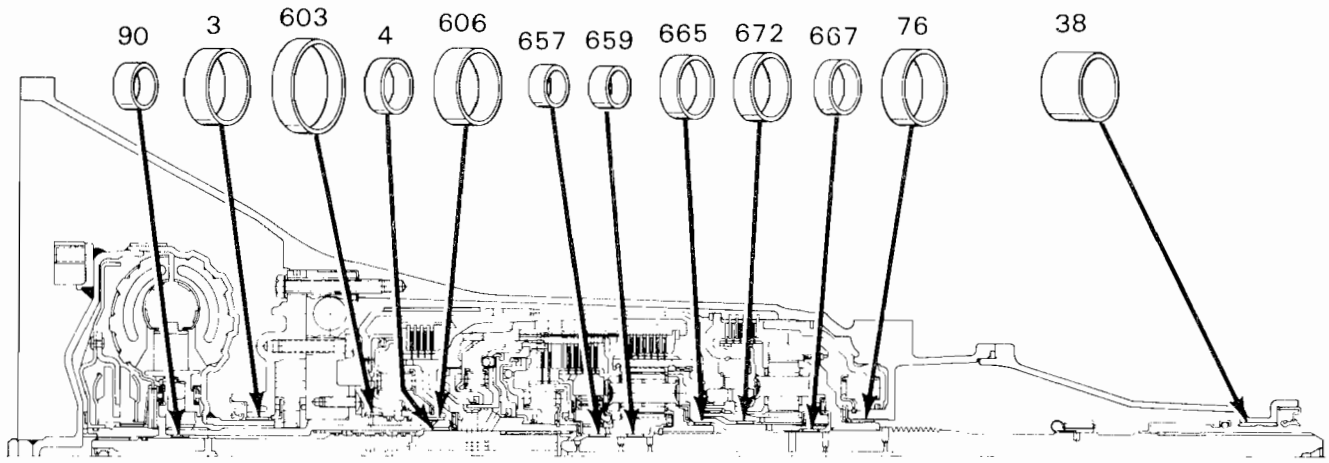


ILL. NO.	DESCRIPTION
601	WASHER, THRUST (PUMP TO DRUM)
608	SEALS, REVERSE INPUT CLUTCH – INNER & OUTER
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
622	SEAL, "O" RING INPUT TO FORWARD HSG.
624	SEAL, 3RD & 4TH CLUTCH – INNER & OUTER
629	SEAL, FORWARD CLUTCH – INNER & OUTER
631	SEAL, OVERRUN CLUTCH – INNER & OUTER
637	BEARING ASSEMBLY, INPUT SUN GEAR

ILL. NO.	DESCRIPTION
663	BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)
669	WASHER, THRUST (REACTION SHAFT/SHELL)
674	WASHER, THRUST (RACE/REACTION SHELL)
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
692	BEARING, REACTION GEAR SUPPORT TO CASE
696	SEAL, TRANSMISSION (LO & REVERSE CLUTCH – OUTER, CENTER – INNER)

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Figure 173 Seals and Bearing Locations



ILL. NO.	DESCRIPTION
3	BUSHING, OIL PUMP BODY
4	BUSHING, STATOR SHAFT (REAR)
38	BUSHING, CASE EXTENSION
76	BUSHING, CASE
90	BUSHING, STATOR SHAFT (FRONT)
603	BUSHING, REVERSE INPUT CLUTCH (FRONT)
606	BUSHING, REVERSE INPUT CLUTCH (REAR)
657	BUSHING, INPUT SUN GEAR (FRONT)
659	BUSHING, INPUT SUN GEAR (REAR)
665	BUSHING, REACTION SHAFT (FRONT)
667	BUSHING, REACTION SHAFT (REAR)
672	BUSHING, REACTION SUN GEAR

TORQUE SPECIFICATIONS

LOCATION	QTY.	SIZE	TORQUE	LOCATION	QTY.	SIZE	TORQUE
ACCUMULATOR COVER TO CASE	2	M6 1.0x35.0	11 N·m (8 FT.-LB.)	PARK BRAKE BRACKET TO CASE	2	M8 1.25x20.0	22 N·m (18 FT.-LB.)
ACCUMULATOR COVER TO CASE	1	M6 1.0x65.0	11 N·m (8 FT.-LB.)	PUMP COVER TO BODY	5	M8 1.25x40.0	22 N·m (18 FT.-LB.)
DETENT SPRING TO VALVE BODY	1	M8 1.75x20.0	22 N·m (18 FT.-LB.)	PUMP ASSY. TO CASE	7	M8 1.25x60.0	22 N·m (18 FT.-LB.)
VALVE BODY TO CASE	15	M6 1.0x50.0	11 N·m (8 FT.-LB.)	CASE EXTENSION TO CASE	4	M10 1.50x30.0	34 N·m (26 FT.-LB.)
OIL PASSAGE COVER TO CASE	3	M6 1.0x16.0	11 N·m (8 FT.-LB.)	MANUAL SHAFT TO INSIDE DET. LEVER	1	M10 1.50 NUT	31 N·m (23 FT.-LB.)
SOLENOID ASSY. TO PUMP	2	M6 1.0x12.0	11 N·m (8 FT.-LB.)	PRESSURE PLUGS	1-4	⅛ - 27	11 N·m (8 FT.-LB.)
TRANSMISSION OIL PAN TO CASE	16	M8 1.25x19.3	11 N·m (8 FT.-LB.)	PRESSURE PLUGS	3	¼ - 18	24 N·m (18 FT.-LB.)
PRESSURE SWITCHES	1-3	⅛ - 27	11 N·m (8 FT.-LB.)	CONNECTOR COOLER PIPE	2	¼ - 18	38 N·m (28 FT.-LB.)

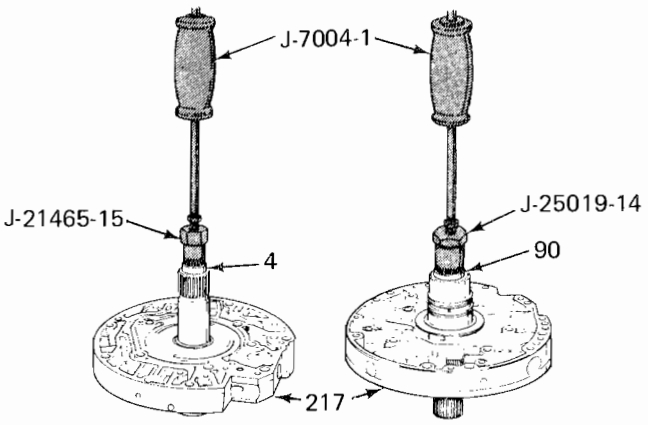
490325-700-R4

Figure 174 Torque Specifications and Bushing Locations

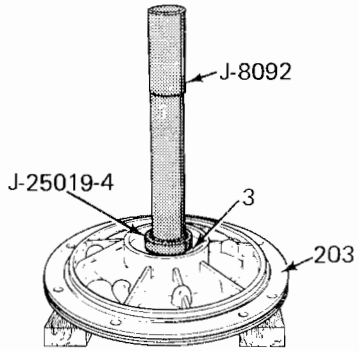
BUSHING REPLACEMENT PROCEDURE

PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

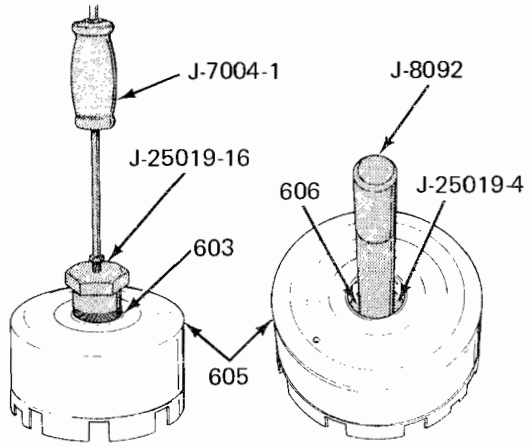
REMOVE AS SHOWN



4 BUSHING, STATOR SHAFT – FRONT
90 BUSHING, STATOR SHAFT – REAR
217 COVER, PUMP

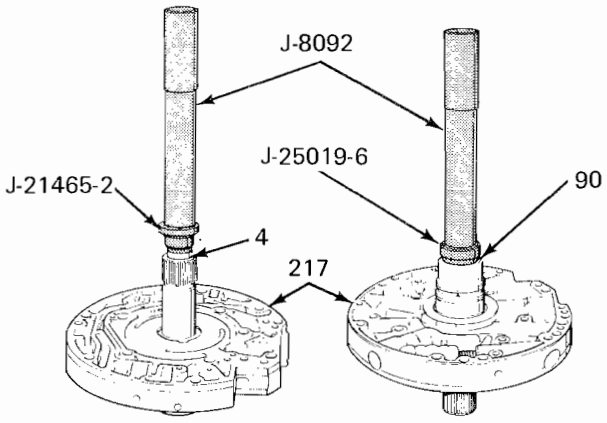


3 BUSHING, OIL PUMP BODY
203 BODY, PUMP

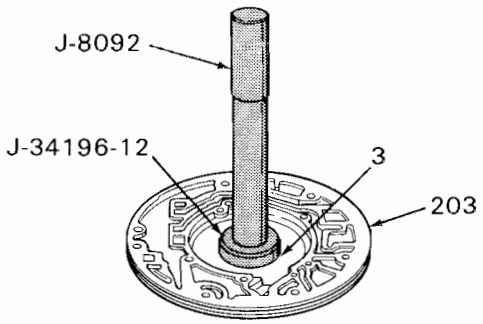


603 BUSHING, REVERSE INPUT CLUTCH – FRONT
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
606 BUSHING, REVERSE INPUT CLUTCH – REAR

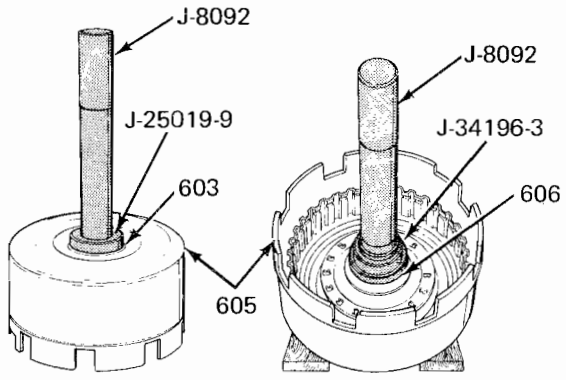
INSTALL AS SHOWN



4 BUSHING, STATOR SHAFT – FRONT
90 BUSHING, STATOR SHAFT – REAR
217 COVER, PUMP



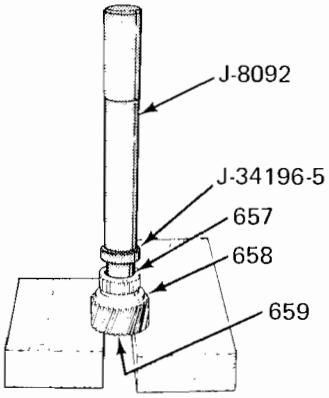
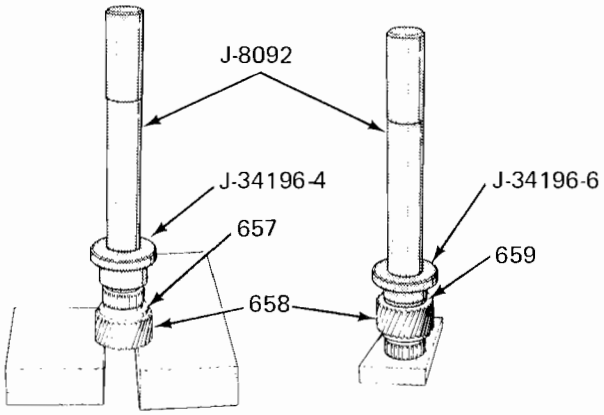
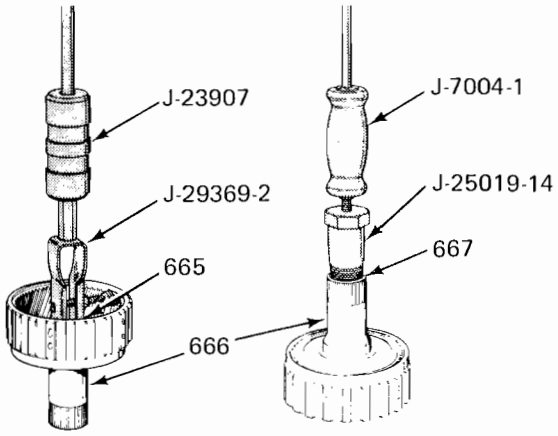
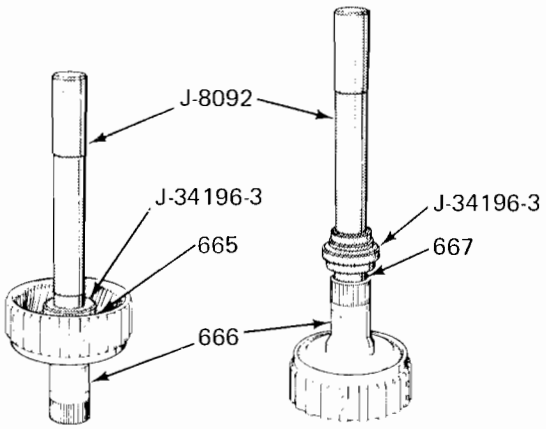
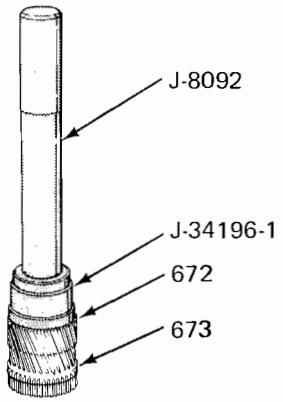
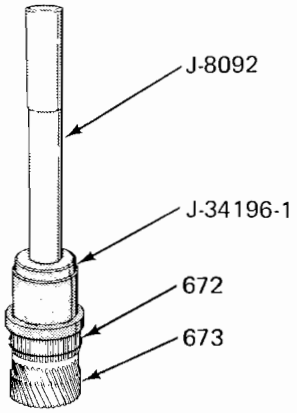
3 BUSHING, OIL PUMP BODY
203 BODY, PUMP



603 BUSHING, REVERSE INPUT CLUTCH – FRONT
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
606 BUSHING, REVERSE INPUT CLUTCH – REAR

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Figure 175 Bushing Replacement Procedure

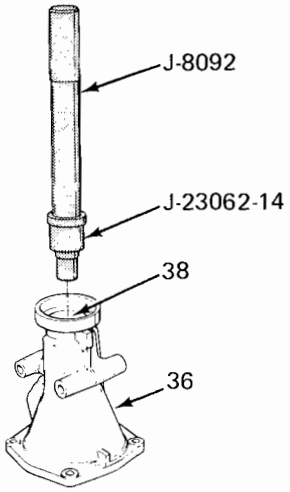
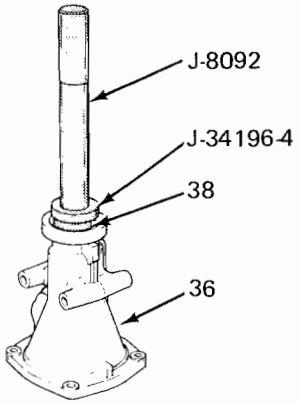
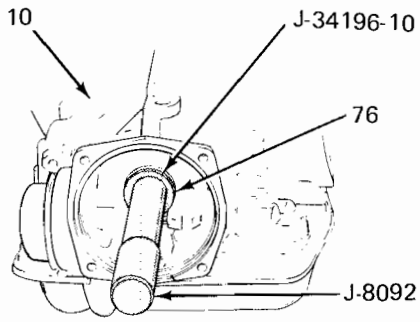
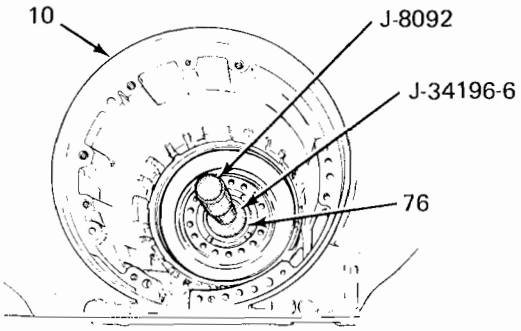
REMOVE AS SHOWN	INSTALL AS SHOWN
	
657 BUSHING, INPUT SUN GEAR – FRONT 658 GEAR, INPUT SUN 659 BUSHING, INPUT SUN GEAR – REAR	657 BUSHING, INPUT SUN GEAR – FRONT 658 GEAR, INPUT SUN 659 BUSHING, INPUT SUN GEAR – REAR
	
665 BUSHING, REACTION CARRIER SHAFT – FRONT 666 SHAFT, REACTION CARRIER 667 BUSHING, REACTION CARRIER SHAFT – REAR	665 BUSHING, REACTION CARRIER SHAFT – FRONT 666 SHAFT, REACTION CARRIER 667 BUSHING, REACTION CARRIER SHAFT – REAR
	
672 BUSHING, REACTION SUN 673 GEAR, REACTION SUN	672 BUSHING, REACTION SUN 673 GEAR, REACTION SUN

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Figure 176 Bushing Replacement Procedure

BUSHING REPLACEMENT PROCEDURE

PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

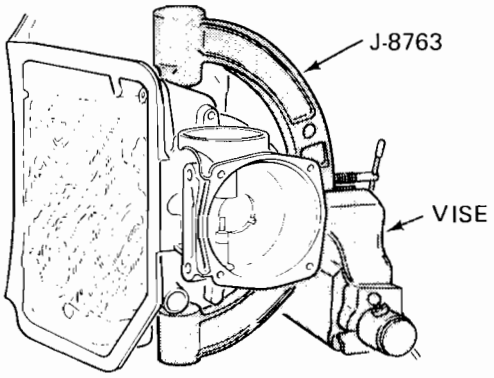
REMOVE AS SHOWN	INSTALL AS SHOWN
	
36 EXTENSION, CASE 38 BUSHING, CASE EXTENSION	36 EXTENSION, CASE 38 BUSHING, CASE EXTENSION
	
10 CASE, TRANSMISSION 76 BUSHING, CASE	10 CASE, TRANSMISSION 76 BUSHING, CASE

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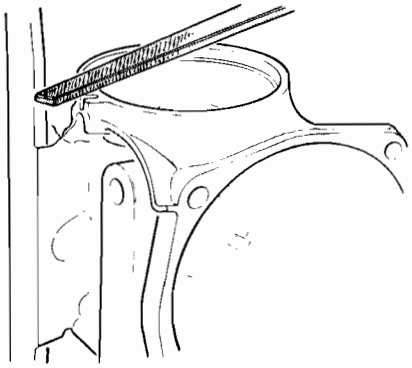
Figure 177 Bushing Replacement Procedure

GOVERNOR BORE REPAIR PROCEDURE

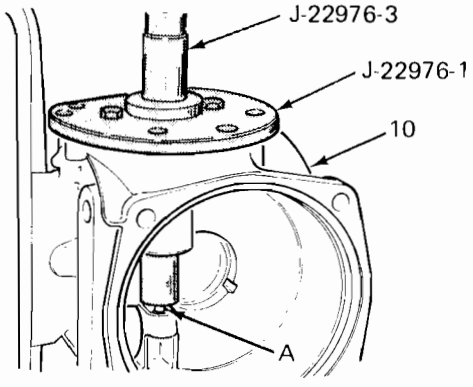
FOLLOW STEPS 1-6 TO REPAIR THE GOVERNOR BORE



STEP 1 Install holding fixture J-28763 and mount in vise.

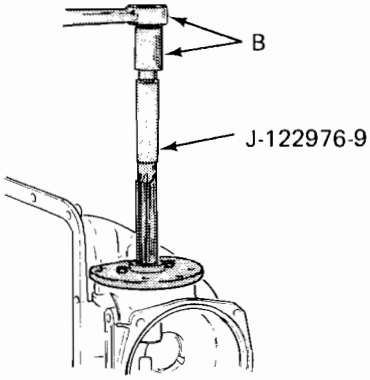


STEP 2 Remove (file) any excess material from the governor face.



A PIN, GOVERNOR SUPPORT
10 CASE, TRANSMISSION

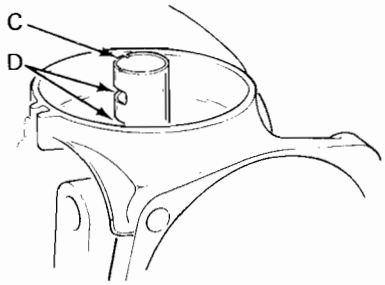
STEP 3 Install J-22976-3 and J-22976-1. Torque bolts to 13 N·m (10 ft.-lbs.). Make sure J-22976-3 rotates freely and then remove it.



B RATCHET & SOCKET

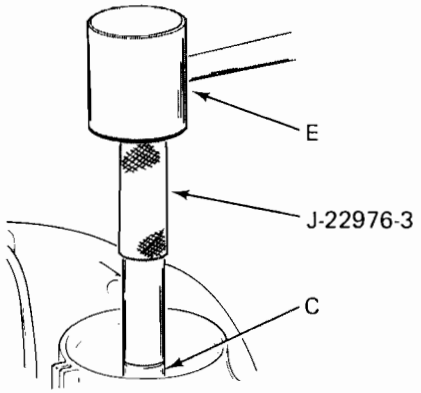
STEP 4 Ream the governor bore as follows:

- Oil J-122976-9, J-22976-1 and the governor bore with transmission fluid.
- After each ten revolutions, remove the reamer and dip in transmission fluid to clean.
- After the reamer reaches the end of the bore and bottoms on the governor support pin, rotate the reamer ten additional revolutions.
- Remove the reamer. Be certain to rotate during removal to prevent scoring the bore.
- Remove the tools and thoroughly clean the case.



C BUSHING
D SLOTS

STEP 5 Align the slots in the bushing with the slots in the governor bore.

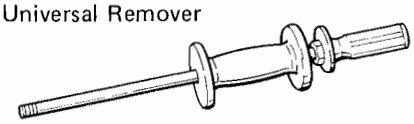
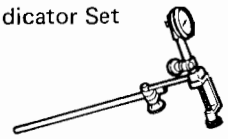
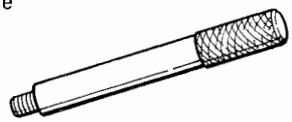
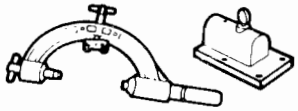
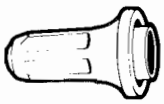
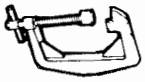
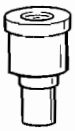
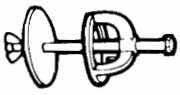
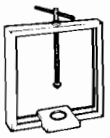
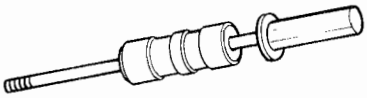
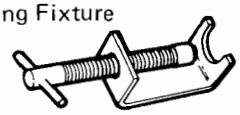
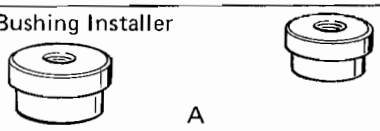
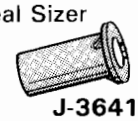
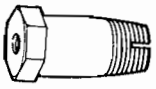
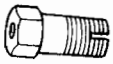
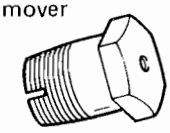
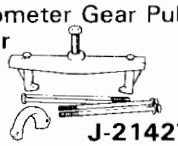
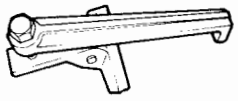
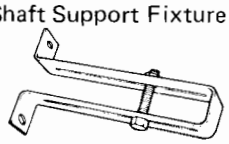
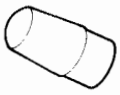
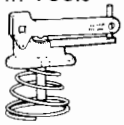
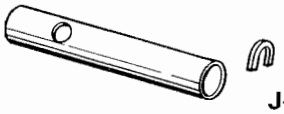
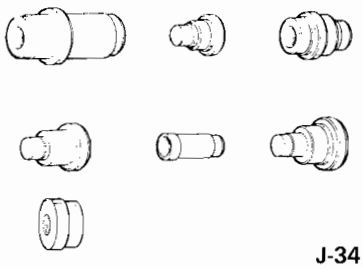


C BUSHING
E BRASS HAMMER

STEP 6 Install the bushing until the slots in the bushing align with the feed holes in the governor bore.

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Figure 178 Governor Bore Repair Procedure

Universal Remover  A J-7004-1	Dial Indicator Set  E J-8001	Handle  E J-8092
Holding Fixture & Base  E J-8763-02	Oil Pump Body & Cover Alignment Band  E J-21368	Rear Seal Installer  E J-21426
Pump Oil Seal Installer  E J-25016	Piston Compressor  E J-22269-01	Bushing Remover  A J-23062-14
Clutch Spring Compressor  E J-23327	Clutch Spring Compressor Adaptor  E J-25018-A	Clutch Spring Compressor Press  E J-23456
Universal Remover  E J-23907	Oil Pump Remover & End Play Checking Fixture  E J-24773-A	End Play Checking Fixture Adaptor  E J-25022
End Play Checking Fixture Adaptor  E J-34725	Bushing Remover  A J-25019-4	Bushing Installer  A J-25019-12 A J-25019-9
Turbine Shaft Seal Installer  J-36418-1 Turbine Shaft Seal Sizer  J-36418-2	Bushing Remover  A J-25019-14 Bushing Remover  A J-24036	Bushing Remover  A J-25019-16
Bushing & Universal Remover Set  J-29369-1 J-29369-2	Speedometer Gear Puller & Adapter  E J-21427-01 & J-8433	Servo Cover Compressor  E J-29714
Output Shaft Support Fixture  E J-29837	Inner Overrun Clutch Seal Protector  E J-29882	Inner Forward Clutch Seal Protector  E J-29883
2-4 Band Apply Pin Tools  E J-33037	Speed Sensor Rotor Installer  J-36352	Bushing Set  A J-34196
Dial Indicator Stand and Guide Pin Set  E J-25025-B	Speedometer Gear Installer  J-5590	

E — Essential Tool A — Available Tool

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Figure 179 Special Tools

SECTION 7B

83 MM (4-SP) MANUAL TRANSMISSION WITH AUTOMATIC OVERDRIVE

RPO - MK2 AND MH5

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GENERAL DESCRIPTION 7B-1
83mm (4-Speed) 7B-1
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Oil Cooler Pipes 7B-11
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GENERAL DESCRIPTION

83 MM (4-SPEED)

Manual transmissions are designated according to A) the number of forward gears, and B) the measured distance between the centerlines of the mainshaft and the countergear.

This transmission is representative of a synchronized constant-mesh transmission design. Fundamental components of this unit is the case, which houses the gears and shaft; the control cover, which houses the shifter mechanism; and the various shafts and gears. The input shaft has an integral main drive gear and rotates with the clutch driven plate; that is, the shaft rotates all the time the clutch is engaged and the engine is running. The input shaft is supported in the case by a ball bearing and at the front end by an oil impregnated bushing mounted in the engine crankshaft. The drive gear is in constant mesh with the countershaft drive gear. Since all gears in the countershaft cluster are integral to the shaft, they also rotate at the time the clutch is engaged. The countergear is carried on roller bearings at both ends and thrust is absorbed by thrust washers located between the countergear and thrust bosses in the case. The transmission mainshaft is held in line with the input shaft by a pilot bearing at its front end, which allows it to rotate or come to rest independently of the input shaft.

Helical gears are incorporated throughout the transmission. The mainshaft gears are free to rotate independently on the mainshaft and are in constant mesh with the countershaft gears. The reverse idler gear is carried on a bushing finish bored in place, and thrust is taken on the thrust bosses of the case and extension for the 4-speed 83 mm. The transmission is fully synchronized in all forward speeds, however, reverse gear is not. The synchronizer assemblies consist of a hub, sleeve, two key springs and three synchronizer keys. The synchronizer hubs are splined to the mainshaft and retained by snap rings. These assemblies permit gears to be selected without clashing, by synchronizing the speeds of mating parts before they engage.

OVERDRIVE UNIT

Four speed manual transmission with automatic overdrive is essentially a combination of two separate transmissions. The first is a conventional 4-speed (83MM) manual system with a 1:1 ratio in 4th gear. The second is a two-speed (overdrive) system electronically controlled by the ECM which operates with a 1:1 and a .68 to one ratio or 1:1 and a .59 to one ratio. By combining these two transmissions, the complete unit is actually capable of operating with seven separate gear ratios. One of which is an overdrive. The two-speed, or overdrive unit performs its function using a planetary gear system in combination with two sets of clutch packs. The output shaft from the manual unit is linked to a 40-tooth input sun gear in the overdrive unit. This, in turn, is meshed with four double planet gears (24 and 30 tooth), which mesh with the 34-tooth output shaft gear The planet gears are mounted in a carrier to which two sets of clutch plates are also attached. The outer plates, when engaged, lock the carrier in place with the transmission housing. The inner clutch plates, when engaged, lock the output shaft to the carrier. These two clutch packs are arranged so that if one is engaged, the other is disengaged. With this set-up, the following two modes of motion are possible:

- With the carrier fixed to the housing, power is transmitted from the input sun gear, through the spinning planet gears, to the freely rotating output shaft. In this way, the double planet gears allow the overdrive ratio to be achieved.
- With the output shaft fixed to the carrier, and the carrier free to rotate, there is no relative motion between the input sun gear and the output shaft. The carrier, planet gears, input sun gear, and output shaft rotate as one assembly. This is the direct drive or 1:1 mode.

The operation of these clutch packs is controlled by a hydraulic circuit which causes the movement of the main finger plate via a piston and accumulator assembly. When the piston is forced down against a series of springs applying approximately 1350 pounds of thrust, the outer (carrier to housing) clutch plates are compressed while the inner plates are released. When the piston is allowed to return to the initial position, the outer plates are released while the inner set is compressed. A sprag clutch is used to avoid a neutral position for the brief periods when both clutch packs are disengaged. The accumulator is used to regulate the speed at which the piston moves, and thus, the speed of the complete shift from direct to overdrive or vice versa. This accumulator is essentially a "cushion" attached to the piston whose firmness is controlled by fluid pressure, and a series of springs by which it is held to the piston.

The hydraulic circuit consists mainly of a gerotor pump on the overdrive units output shaft, and a shift valve and solenoid, an accumulator valve, and a pressure relief valve all located in the valve body assembly. In the normal (direct drive) mode fluid circulates from the pump through the 115-125 PSI pressure relief valve, and through the cooler lines then back to the pan or sump area. A small amount is also circulated through the shift valve and solenoid. When the overdrive switch is closed by the ECM, the solenoid plunger is activated. This causes the shift valve to provide an open channel for flow into the piston. With a new path by which fluid can flow, the relief valve lines experience a drop in pressure causing the valve to close, and subsequently, routing nearly all flow to the piston. A similar valve in the cooler lines also close if pressure drops below 70 PSI. The piston then moves against its springs and activates the overdrive mode. When the piston stroke is complete, pressure returns to the cooler lines and reopens the pressure relief valve. Flow to the piston ceases, but the 115-125 PSI pressure maintains position as long as the shift solenoid is energized. When the solenoid de-energizes, the shift valve returns to the original position. Fluid is forced from the piston as the springs move it back to the direct drive position. The speed at which this downshift occurs is regulated by an orifice in the shift valve exhaust line and by an orifice in the accumulator lines. When low speed upshifts occur, the valve maintains a low accumulator pressure. The accumulator slides forward as pressure builds on the piston. In this way the complete piston stroke is slowed allowing more slipping of the clutch plates, and thus, a smooth shift to the overdrive mode. When high speed shifts occur, pressure to the accumulator is high. The accumulator and piston move completely together. This causes a much faster piston stroke and subsequent shift to overdrive which is desirable at high speeds.

The ECM is programmed to control the shift solenoid and thus, the entire overdrive unit. It does this by monitoring vehicle speed, throttle position and engine RPM. Rapid acceleration will cause a shift from the overdrive to direct mode. When a crusing throttle position is then used, the overdrive mode is restored in fourth gear, but it will not return in second or third gear. Overdrive is automatically engaged at speeds above 110 mph. The overdrive mode can be forced off by means of a switch on the vehicle shift lever knob.

MAINTENANCE AND ADJUSTMENTS

LINKAGE ADJUSTMENT (FIGURE 7B-3)

1. Disconnect the negative battery cable.
2. Remove the left seat from the vehicle. If equipped with power seats, disconnect the electrical leads.
3. Remove the shift knob.
4. Remove the console cover.
5. Remove the glove box lock.
6. Remove the left side panel from the console.
7. Remove the shifter cover.
8. Loosen the adjusting nuts on the shifter rods.
9. With the transmission and shifter in neutral, install the alignment pin in shifter as shown.
10. Equalize the swivels on all three shift levers. Hand tighten the forward and rear adjusting nuts at the same time with equal force. Do this for all three shifter rods and then torque the forward and rear adjusting nuts at the same time to specifications.
11. Reinstall the components removed by reversing Steps 1 through 7.

CONDITION	PROBABLE CAUSE	CORRECTION
Slips out of High Gear	a. Transmission loose on clutch housing b. Shift linkage does not work freely; binds c. Damaged mainshaft pilot bearing d. Main drive gear retainer broken or loose e. Dirt between transmission case and clutch housing f. Misalignment of transmission g. Pilot bearing loose in crankshaft h. Worn or improperly adjusted linkage	a. Tighten mounting bolts b. Adjust and free up shift linkage c. Replace pilot bearing d. Tighten or replace main drive gear e. Clean mating surfaces f. Refer to TRANSMISSION ALIGNMENT g. Replace bearing h. Adjust or replace linkage as required
Noisy in All Gears	a. Insufficient lubricant b. Worn countergear bearings c. Worn or damaged main drive gear and countergear d. Damaged main drive gear or main shaft bearings e. Worn or damaged countergear	a. Fill to correct level b. Replace countergear bearings and shaft c. Replace worn or damaged gears d. Replace damaged bearings or main drive gear e. Replace countergear
Noisy in High Gear	a. Damaged main drive gear bearing b. Damaged mainshaft bearing c. Damaged high speed gear synchronizer	a. Replace damaged bearing b. Replace damaged bearing c. Replace synchronizer
Noisy in Neutral with Engine Running	a. Damaged main drive gear bearing b. Damaged or loose pilot bearing c. Worn or damaged countergear d. Worn countergear bearings	a. Replace damaged bearing b. Replace pilot bearings c. Replace countergear d. Replace countergear bearings and shaft
Noisy in all Reduction Gears	a. Insufficient lubricant b. Worn or damaged main drive gear or countergear c. Damaged main drive gear brg.	a. Fill to correct level b. Replace faulty or damaged gears c. Replace bearing
Noisy in Second Only	a. Damaged or worn second-speed gears b. Worn or damaged countergear rear bearings c. Damaged or worn second-speed synchronizer	a. Replace gears b. Replace countergear bearings and shaft c. Replace synchronizer
Noisy in Third Only (Four Speed)	a. Damaged or worn third-speed gears b. Worn or damaged countergear bearings	a. Replace gears b. Replace countergear bearings and shaft
Noisy in Reverse Only NOTE: Reverse gear operation is noisier than forward gear operation due to spur gears	a. Worn or damaged reverse idler gear or idler bushing b. Worn or damaged reverse gear on mainshaft c. Damaged or worn reverse countergear d. Damaged Shift mechanism	a. Replace reverse idler gear assembly b. Replace reverse gear c. Replace countergear assembly d. Inspect linkage and adjust or replace
Excessive Backlash in all Reduction Gears	a. Worn countergear bearings b. Excessive end play in countergear	a. Replace bearings b. Replace countergear thrust washers
Main Drive Gear Bearing Retainer Burned or Scored by Input Shaft	a. Loose or damaged pilot bearing b. Misalignment of transmission	a. Replace bearing b. Align transmission
Leaks Lubricant	a. Excessive amount of lubricant in transmission b. Loose or broken drive gear bearing retainer c. Drive gear bearing retainer gasket damaged d. Side cover loose or gasket damaged e. Countershaft loose in case	a. Drain to correct level b. Tighten or replace retainer c. Replace gasket d. Tighten cover or replace gasket e. Replace case

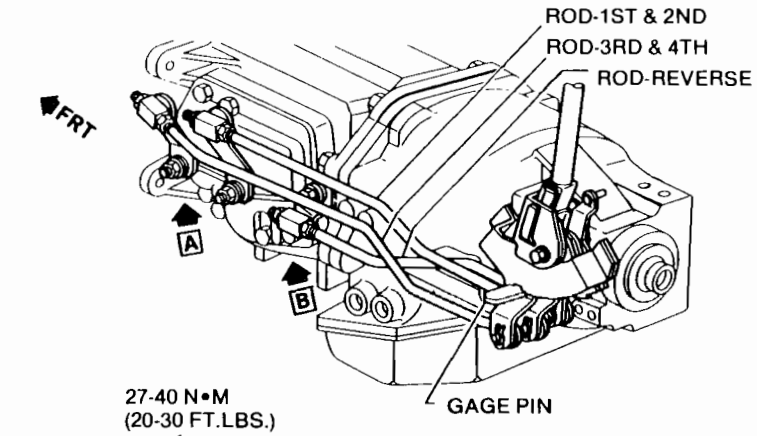
Figure 7B-1–Diagnosis (83 mm)

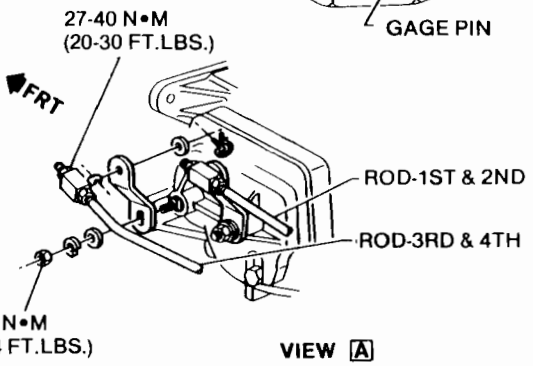
CONDITION	PROBABLE CAUSE	CORRECTION
Overdrive Inop	a. Insufficient Lubricant b. Speedometer Inop c. Blown Fuse d. Temperature Gage Inop e. O/D Switch at Shifter Knob f. Solenoid Inop Check for (12 volts at O/D Connector—Engine at operating temp.—wheels off the ground shift trans from 1st into 2nd gear at 12-15 MPH—solenoid should energize at this point) g. Solenoid Check Ball Missing h. Low Pressure Switch i. Shift Valve Inop j. Pressure Regulator Valve Inop k. Drive Pin Broken or Missing in Pump	a. Fill to correct level b. Replace speedometer sensors. Replace speedometer drive or driven gears. c. Replace fuse d. Replace gage or sending unit e. Replace switch or repair wires f. Replace solenoid or repair wires. g. Install check ball h. Replace switch i. Free up valve or replace valve body j. Free up valve or replace valve body k. Replace pin or pump gears
Overdrive in All Gears	a. Solenoid Plunger Stuck b. Solenoid Exhaust Hole Plugged c. Shift Valve Stuck	a. Replace Solenoid b. Clear exhaust passage c. Free up shift valve or replace valve body
Harsh Up Shifts	a. Stuck T.V. Valve b. Stuck Accumulator Piston c. Accumulator Seal Damaged	a. Free up valve or replace valve body b. Free up or replace c. Replace seal
Harsh Down Shifts	a. Stuck T.V. Valve	a. Free up valve or replace valve body
Soft Up Shift	a. Stuck T.V. Valve b. O/D Clutch Plates Burn't	a. Free up valve or replace valve body b. Replace clutch plates and disc's
Soft Downshift	a. Stuck T.V. Valve	a. Free up valve or replace valve body
No Downshift	a. E.C.M., throttle position switch	a. Repair or replace E.C.M. or throttle position switch
Slips on Upshift	a. Direct Clutch Plates Burn't b. Excessive Clutch Pack Clearance	a. Replace direct clutch plates and disc's b. Adjust clutch pack clearance
Chatters on Upshifts	a. Piston Seals Damaged b. Direct Clutch Plates Burn't c. Low mainline pressure	a. Replace seals b. Replace direct clutch plates and disc's c. Check lines for restrictions. Check pump.

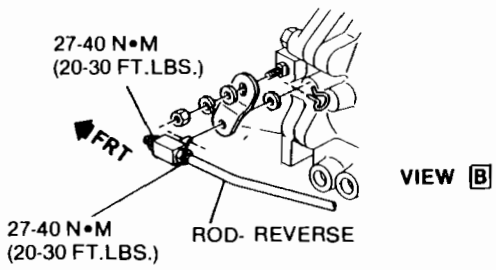
Figure 7B-2–Diagnosis (Overdrive)

CONDITION	PROBABLE CAUSE	CORRECTION
O/D Overheats	a. Insufficient Lubricant b. Stuck Cooler Valve c. Cooler Line Restriction d. Restriction in Radiator	a. Fill to correct level b. Free up cooler valve or replace valve c. Flush lines or replace d. Flush radiator or replace
No Reverse	a. Direct Clutch Plates Burn't	a. Replace direct clutch plates and disc's
Noisy in Direct Drive	a. Front Carrier Bearing b. Thrust Bearing in Direct Clutch	a. Replace carrier cover b. Replace thrust bearing
Noisy in Overdrive	a. Pinion Roller Bearings b. Pinion Gears (scored, chipped or burn't) c. Input Sun Gear (scored, chipped or burn't) d. Output Sun Gear (scored, chipped or burn't)	a. Replace carrier cover or housing b. Replace pinion gears c. Replace input sun gear d. Replace output sun gear
No Direct Drive	a. Sprag Clutch Damaged	a. Replace Sprag Clutch

Figure 7B-2a–Diagnosis (Overdrive)



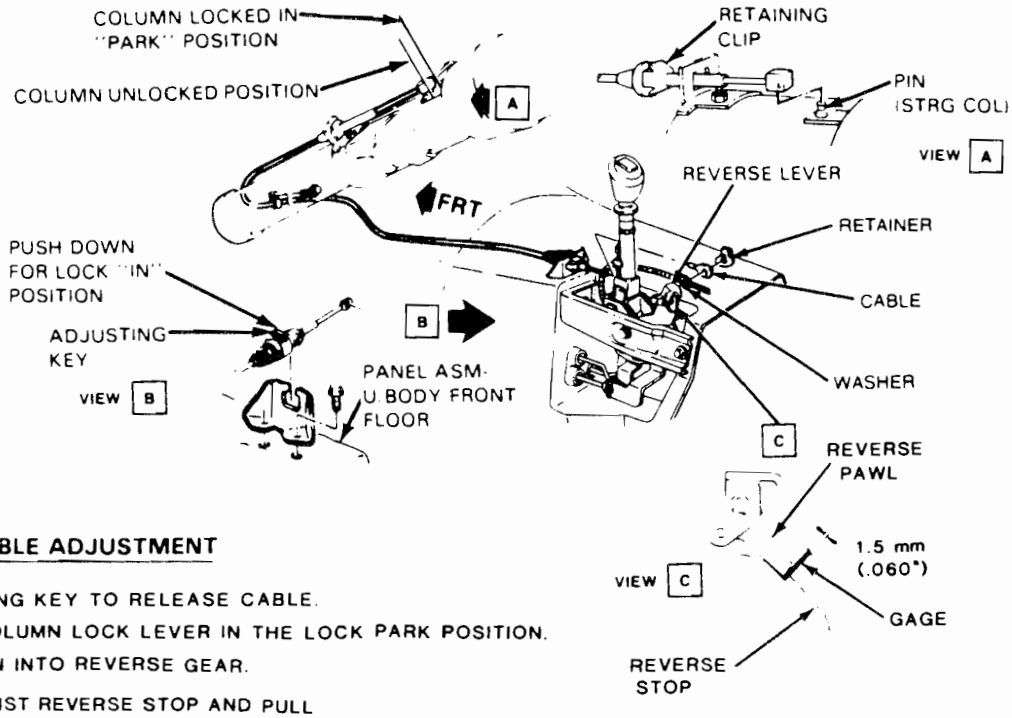




ADJUSTMENT PROCEDURE

1. Shift transmission into neutral position.
2. Place control assembly into neutral and install gage pin.
3. With swivel equalized on all three levers, hand tighten the forward and rear nuts with equal force. Then torque both nuts simultaneously to specified torque.
4. Remove gage pin.

Figure 7B-3–Linkage Adjustment



CABLE ADJUSTMENT

1. LIFT UP ON ADJUSTING KEY TO RELEASE CABLE.
2. PLACE STEERING COLUMN LOCK LEVER IN THE LOCK PARK POSITION.
3. SHIFT TRANSMISSION INTO REVERSE GEAR.
4. INSERT GAGE AGAINST REVERSE STOP AND PULL REVERSE LEVER UNTIL REVERSE PAWL CONTACTS GAGE.
5. PUSH DOWN ON THE ADJUSTING KEY TO SET THE CABLE.
6. REMOVE GAGE AND PULL BACK ON SHIFT LEVER AND INSURE PAWL HITS THE STOP AND LOCKS SHIFTER IN REVERSE.

Figure 7B-4–Park Lock Cable Adjustment

PARK LOCK CABLE

Adjustment

Refer to Figure 7B-4 for adjustment procedure.

DIAGNOSIS

TRANSMISSION SHIFT EFFORT

Transmission Shift Effort Checking Procedures

1. Remove the shift rods at the transmission and align the sleeve, blocker ring and gear by shifting into the offending gear and then back into neutral.
2. Check the torque required to shift into gear with an inch pound torque wrench on the shift lever attaching bolt. If more than the specified torque is required (72 in. lbs. Max.), the transmission shift lever should be checked for rust or dirt binding the lever.
3. Clean levers, lubricate and recheck the torque value.
4. If at this point in the procedure, it is found that high shift effort still exists, an anti-chatter lubricant (positraction additive) may be used. The lubricant is available in a small plastic bottle and can be squirted into the transmission through the filler plug.

Transmission Internal Problems Related to Shift Effort

When the above procedures have been checked and the problem still exists, the transmission will have to be removed and disassembled for further diagnosis. There are three basic types of transmission internal problems reflected by shifting effort.

- **Hard Shifting** - The effort to shift is excessive, but the gears engage. The lever moves with excessive effort throughout the entire travel range. If the static shift effort is high, (clutch depressed, engine not running), the synchronizer sleeve and hubs should be checked for a tight fit. With the three synchronizer keys removed, the sleeve should be loose on the hub. If the hub and sleeve are not a loose fit, replace the synchronizer assembly.

- **Blockout** - The lever moves freely until the synchronizer is engaged. Synchronization should be heard to take place, but the gear will not engage. When it does engage, a double bump is generally felt in the lever. The synchronized blocker ring can be damaged by excessive force on gear cones that are finished improperly. The blocker ring material may stick to the synchronizer gear cone causing it ito be a yellowish brass color, in streaks, which results in hard shifts when present. The gear cone should be a bright silver color. Polish the gear cone with 400 grit paper to a bright silver when the condition is present. The blocker rings should be replaced if the thread is damaged or worn.
- **Clash** - Gear clash is a sound which sometimes occurs when the sleeve and gear chamfers contact each other in the unsynchronized state. The characteristics of clash are a grating or loud buzzing sound from the transmission. The shift lever load will be lower, but a vibration should be felt. The noise (clash) can be for a short instant or long enough to keep the gear from being engaged. This condition should not be confused with hard shifting or reported as such. Hard shifting and clash are directly opposite conditions. When the clash is slight, the load will build up on the shift lever and then fall off rapidly followed by the grating sound. If the transmission has been clashing, the sleeve ends should be examined for chipping and burrs. If the sleeves are damaged, the synchronizer assemblies and blocker rings should be replaced. Synchronizer sleeve ends should have an angular surface. The surfaces should be even from side to side and the radii indicated should be very small. Any chipping will require synchronizer replacement. Check the synchronizer load. When the keys are installed, the spring ends on one side of the hub should be hooked in one key and the spring on the opposite side of the synchronizer should not be hooked on the same key. A definite load should be felt when the sleeve is moved on the hubs with the keys and springs in proper position.

TRANSMISSION ALIGNMENT

In some instances where excessive gear whine or high gear hop out, particularly at 50 mph (80 km/h) and up, are encountered, and after all other probable causes have been checked, an alignment check of the transmission and clutch housing may be helpful.

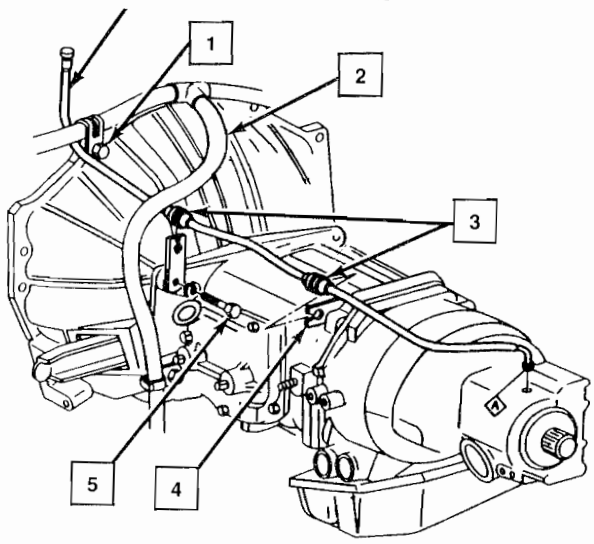
A special tool, on which a dial indicator is mounted, is necessary to check the transmission case rear bore alignment. This tool may be made from a new or good used clutch gear which has a good bearing surface on the crankshaft pilot end and at the front main bearing location.

The splines on the clutch gear shaft and the teeth on the clutch gear should be ground off so the shaft may be rotated in a clutch disc hub without interference when assembled in the vehicle. Weld a piece of 1/4 in. (6.3mm) rod in the mainshaft pilot bore long enough to extend out the case rear bore. Assemble a good bearing on the clutch gear shaft and secure it with the clutch gear bearing snap ring. Attach a suitable dial indicator to the rod.

1. Remove the transmission from the vehicle and completely disassemble, except for the reverse idler gear. In any case where the clutch gear pilot or pilot bearing is excessively loose or worn, the pilot bearing should be replaced before checking the transmission case rear bore alignment by the dial indicator method.
2. Carefully install the special tool with the dial indicator in the transmission case with the face of the indicator to the rear of the case and with the tracing finger contacting the I.D. of the case rear bore. Secure in place with a clutch gear bearing retainer.
3. Assemble the transmission case to the clutch housing and tighten the four transmission mounting bolts securely. Be sure to clean off any paint or other foreign material on the mating faces of the clutch housing and transmission as any foreign material on these faces will change alignment; also, check carefully for dings or burrs on these mating surfaces and remove carefully as necessary.
4. Dial indicate the transmission case rear bore and record the indicator readings in the 12, 3, 6 and 9 o'clock positions. It is best to start the reading at the 3, 6, 9 or 12 o'clock position closest to the point where the indicator plunger reaches its maximum outward travel. Set the dial indicator at "O" at this location and then record the 3, 6, 9 and 12 o'clock readings in rotation.
5. Install temporary slotted shims between the transmission case and the clutch housing in the quantities and at the bolt locations as necessary to bring misalignment at the transmission case rear bore to amaximum of 0.005 in. indicator reading in either the vertical or horizontal direction. EXAMPLE: If the maximum indicator reading is at the 12 o'clock position, put shims on the two bottom bolts.
6. After the position and quantity of shims has been determined and recorded, the transmission case may be removed.

NOTICE: The clutch housing should then be stamped, showing the position where shims are to be installed and the thickness of shims at each location.

7. Inspect the external clutching teeth of the clutch gear and second speed gear. Inspect the second and third speed clutch internal clutching teeth. If the teeth are worn or tapered, even slightly, the gears should be replaced. Reassemble the transmission.
8. Install the transmission assembly to the clutch housing, using the correct number of shims at the proper locations as previously determined. Shims are available by unit part number with each unit consisting of the following shims: 4--.002″ shims Identification--two corners cut off. 2--.005″ shims Identification--one corner cut off. 1--.010″) shims Identification--all corners square. These



1. HARNESS BRACKET
2. E.C.M. HARNESS
3. TUBE GROMMET
4. TRANSMISSION BRACKET
5. BOLT
   60-80 N·m (45-60 FT. LBS.)

Figure 7B-5–Transmission Attachments

special shims have a tab on one end for ease of installation. Do not slot the shims for the permanent installation.

ON VEHICLE SERVICE

TRANSMISSION (FIGURE 7B-5)

Removal

1. Disconnect the negative battery cable.
2. Remove the distributor cap and lay aside.
3. Raise the vehicle and support on stands.
4. Remove the upper and lower underbody braces on vehicles equipped with a convertible top.
5. Remove the complete exhaust system as an assembly by:
   a. Disconnect A.I.R. pipe at the converter.
   b. Disconnect A.I.R. pipe clamps at exhaust manifold.
   c. Disconnect oxygen sensor electrical lead.
   d. Remove the exhaust hanger bolts at the driveline support beam.
   e. Remove the bolts attaching the mufflers to the hangers.
   f. Remove hanger bracket at the converter.
   g. Disconnect the exhaust pipes from the exhaust manifolds and remove the exhaust system.
6. Remove the exhaust hanger at the transmission.
7. Support the transmission with a jack.
8. Remove the bolts attaching the driveline support beam at the axle and transmission. Remove the driveline support beam from the vehicle.
9. Mark the relationship of the propeller shaft to the axle companion flange. Remove the trunnion bearing straps and disengage the rear universal joint from the axle. Slide the propeller shaft slip yoke out from the overdrive unit and remove shaft from the vehicle.
10. Disconnect the cooler lines at the overdrive unit.
11. Disconnect the shift linkage at the side cover.
12. Disconnect the electrical connectors at the transmission--backup light switch (1), overdrive unit (1), 1st gear switch (1) and speedometer sensor(1).
13. Lower the transmission and support the engine.
14. Remove the (4) bolts attaching the transmission to the clutch housing. Slide the transmission rearward to disengage the input shaft from the clutch. Remove the transmission from the vehicle.
15. Inspect the clutch components. If it requires repair, refer to the Clutch Section (7C).

Installation

1. Clean and repack the clutch release bearing.
2. Install transmission and attaching bolts. Torque transmission bolts to 60-80 N·m (45-60 ft. lbs.).
3. Connect oil cooler line pipes to the overdrive unit. Torque fittings to 11-16 N·m (8-12 ft. lbs.).
4. Install and align the driveline support beam as follows:
   - To insure proper alignment of the driveline, a clearance of 45mm ± 6 (1.77″ ± .250″) must be maintained between the top of the beam to the underbody and a clearance of 28mm ± 6 (1.1″ ± .250″) from the right side (passenger side of vehicle) of the beam to the side wall.
   - Take these measurements directly above and to the right of the propeller shaft yoke.
   - Refer to the Rear Suspension Section (3D) for sealing and torque specifications.

NOTICE: Do not over torque the bolts attaching the driveline beam to the transmission. Over torquing can damage the bushing and seal in the overdrive unit and result in fluid leakage. Inadequate fluid level will damage the transmission.

5. Install the propeller shaft. Refer to Propeller Shaft Section (4A) for installation and torque specifications.
6. Connect and adjust shift linkage as outlined in this section.
7. Connect the electrical connectors for the backup light switch, overdrive unit, speedometer senor and 1st gear switch.
8. Refill the transmission with fluid - (4 Speed) SAE-80W or SAE-80W-90 GL-5 gear lube (Overdrive Unit) Dexron II Automatic Transmission Fluid.

9. Install exhaust system. Refer to Exhaust System Section (6F) for installation and torque specifications.
10. Install the upper and lower underbody braces on vehicles equipped with a convertible top. Refer to the Body Section for installation and torque specifications.

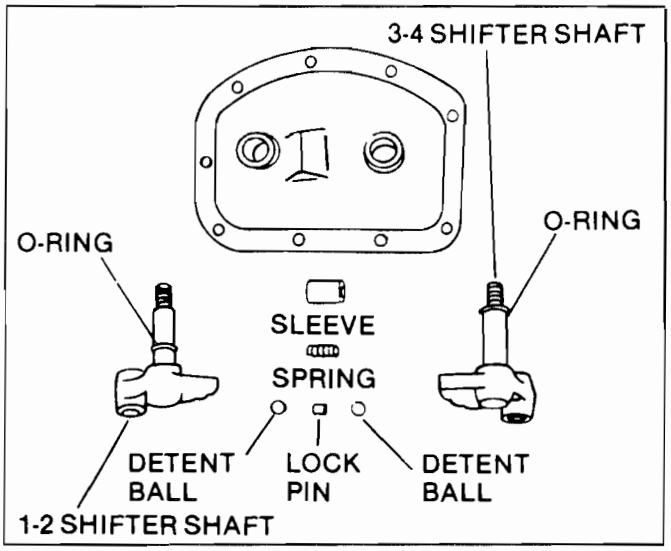


Figure 7B-6–Side Cover

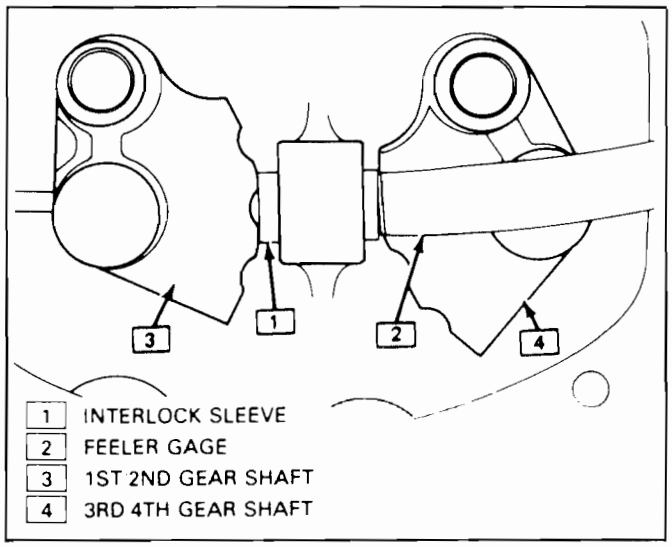


Figure 7B-7–Measuring Interlock Sleeve Clearance

SIDE COVER (FIGURE 7B-6)

Removal

1. Disconnect the negative battery cable.
2. Shift the transmission into second gear.
3. Raise vehicle on hoist.
4. Remove shift levers from the shifter shafts.

1x5. Disconnect electrical wire at 1st gear switch.

6. Remove cover attaching bolts, remove cover assembly and allow transmission to drain.

Disassembly

1. Remove the outer shifter lever nuts and lockwasher and pull levers from shafts.
2. Carefully push the shifter shafts into cover, allowing the detent balls to fall free, then remove both shifter shafts.
3. Remove interlock sleeve, interlock pin and poppet spring.
4. Clean and inspect components and replace damaged parts.

Assembly

1. Assembly is accomplished by reversing Steps 1 through 4.
2. Check the interlock sleeve clearances as follows:
   a. Position the 1st/2nd gear shifter shaft in the neutral detent. Rotate the 3rd/4th gear shifter shaft aganist the 3rd gear stop. Place a feeler gage between the interlock sleeve and the stop as shown in Figure 7B-7 and measure the clearance.
      - Specification - .001″ to .004″
   b. With the 1st/2nd gear shifter shaft in the neutral detent, rotate the 3rd/4th gear shifter shaft against the 4th gear stop. Place a feeler gage between the interlock sleeve and the stop and measure the clearance.
      - Specification - .007″ max.
   c. Position the 3rd/4th gear shifter shaft in the neutral detent. Rotate the 1st/2nd gear shifter shaft against the 1st gear stop. Place a feeler gage between the interlock sleeve and the 1st gear stop and measure the clearance.
      - Specification - .007″ max.
   d. With the 3rd/4th gear shifter shaft in the neutral detent, rotate the 1st/2nd gear shifter shaft against the 2nd gear stop. Place a feeler gage between the interlock sleeve and the stop and measure the clearance.
      - Specification - .007″ max.

If any of the above measurements are not within the specification shown, replace the interlock sleeve.

The interlock sleeve is available in 12 sizes in .0015″ increments.

Installation

1. Shift shifter levers into second gear position. Position cover gasket on case.
2. Carefully position the side cover into place making sure the shift forks are aligned with their respective mainshaft synchronizer sliding sleeves.
3. Install cover attaching bolts and tighten evenly to specified torque.
4. Connect shift levers to shifter shafts.
5. Connect wire to 1st gear switch.
6. Remove filler plug and add lubricant to level of filler plug hole.
7. Lower the vehicle from the hoist.
8. Connect negative cable at battery.

SHIFTER ASSEMBLY (FIGURE 7B-8)

Removal

1. Disconnect the negative battery cable.

1. SHIFTER ASSEMBLY
2. STRAP
3. NUT
4. BOLT
   14-20 N·m (10-15 FT. LBS.)
5. BRACKET
6. WASHER
7. BOLT
   20-30 N·m (15-23 FT. LBS.)
8. BOLT
   30-40 N·m (23-30 FT. LBS.)
9. GROMMET
10. BOLT
    2 N·m
11. PARK LOCK CABLE
12. ROD — 1ST/2ND
13. ROD — REVERSE
14. ROD — 3RD/4TH
15. RETAINER
16. O/D SWITCH HARNESS

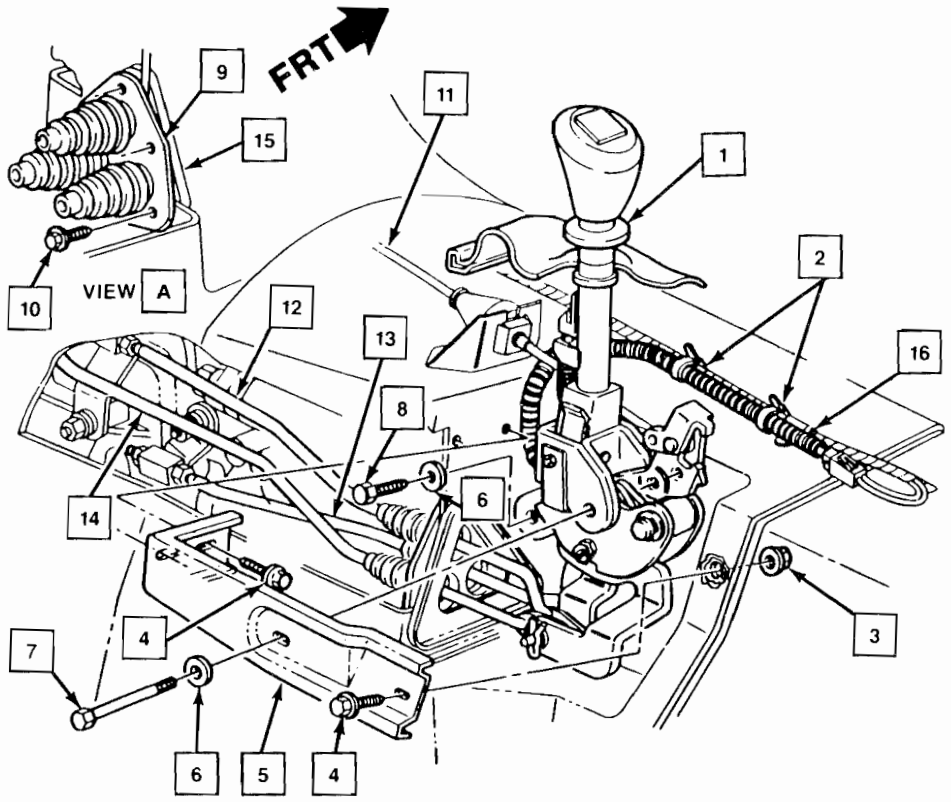


Figure 7B-8–Shifter Attachments

2. Remove the left seat from the vehicle. If equipped with power seats, disconnect the electrical leads.
3. Remove the knob from the shift lever.
4. Remove the console cover.
5. Remove the glove box lock.
6. Remove the left side panel from the console.
7. Remove the shifter cover.
8. Disconnect the 3 rods at the shifter.
9. Disconnect the park lock cable from the shifter.
10. Disconnect overdrive switch electrical connector.
11. Remove the shifter cross bolt.
12. Remove the shifter mounting bracket.
13. Remove the shifter mounting bolt at the body panel and remove the shifter assembly from the vehicle.

Installation

1. Position the shifter to the body and install the mounting bolt. Torque to specification.
2. Position the mounting bracket to the shifter and install bracket bolts. Torque to specification.
3. Install the shifter cross bolt and torque to specifications.
4. Connect the 3 rods to the shifter.
5. Adjust the shift linkage as previously outlined.
6. Connect the park lock cable to the shifter and adjust as follows:
   a. Place the steering column lock lever in the "Lock Park Position".
   b. Shift the transmission into reverse gear.
   c. Push down on the lock tab on the park lock cable.
7. Connect electrical lead for the overdrive switch.
8. Reinstall the remaining components by reversing Steps 1 through 7.

OVERDRIVE SWITCH (FIGURE 7B-9)

Removal

1. Disconnect negative cable at battery.
2. Remove the screws retaining trim plate for the instrument cluster. Remove the knob for the headlamp switch, lever for tilt steering column and then the trim plate.
3. Remove the screws retaining I.P. accessory trim plate and then remove the trim plate.
4. Remove the screws retaining console trim plate. Pull trim plate back and disconnect electrical lead for cigarette lighter. Remove screws retaining shift boot to trim plate, them remove trim plate.
5. Remove the overdrive switch button from the shifter knob. Use care when prying button from the knob to prevent damaging the knob or button.
6. Remove the rod for the overdrive switch from the shifter. Count the number of turns required to remove the rod.
7. Loosen the nut retaining the switch to the shifter and remove the switch and actuator block from the shifter.

   Care must be taken to prevent the loss of the return spring located in the actuator block.
8. Disconnect the electrical lead for the switch.
9. Remove the pin retaining the switch to the actuator block.

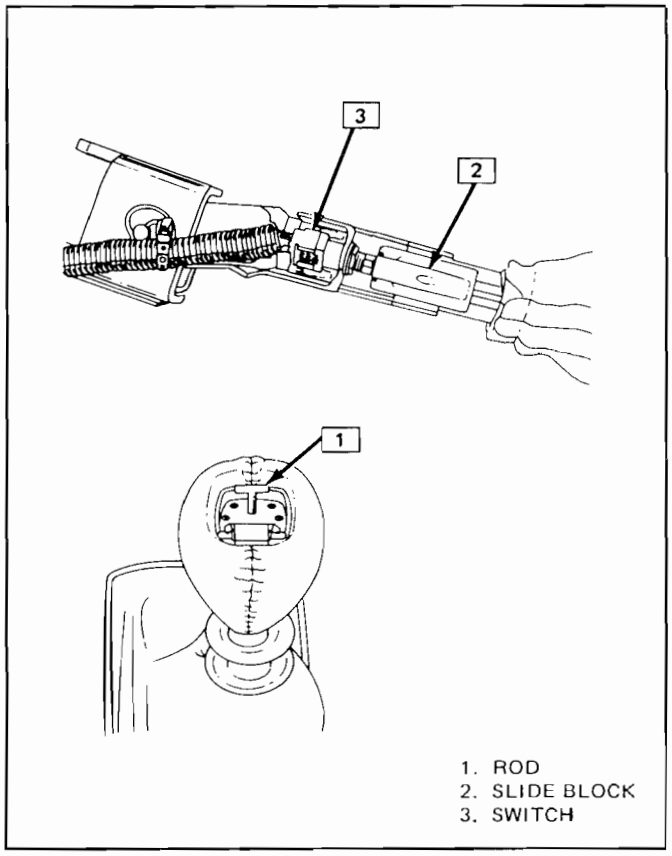


Figure 7B-9 Overdrive Switch

Installation

1. Position the switch to the actuator block and install retaining pin. Lubricate the sliding surface on the actuator block with grease.
2. Compress the return spring in the actuator block using a small screwdriver, then position the switch and block on the shifter.
3. Tighten the switch retaining nut. Apply Loctite #1052624 or equivalent on the threads before tightening.
4. Install the overdrive switch rod in the shifter. Screw the rod into the actuator block the same amount of turns it took to remove. Install the switch button.

   The button should be flush with the top of the shift knob. If it is not, remove the button and turn the rod in or out to make it flush.
4. Connect electrical lead for the switch.
5. Position the console trim plate to the shifter boot and install retaining screws.
6. Connect the electrical lead for the cigarette lighter.
7. Position the console trim plate and install the retaining screws.
8. Position the I.P. accessory trim plate and install the retaining screws.
9. Position the instrument cluster trim plate and install the retaining screws. Install the knob for the headlamp switch and the lever for the tilt steering colum.
10. Connect negative cable at battery.

OIL COOLER PIPES (FIGURE 7B-10)

If replacement of transmission steel tubing cooler lines is required, use only double wrapped and brazed steel tubing meeting GM specification 123M or equivalent. Under no condition use copper or aluminum tubing to replace steel tubing. Those materials do not have satisfactory fatigue durability to withstand normal vehicle vibrations. Steel tubing should be flared using the double flare method.

COOLER LINE FLUSHING

In a major transmission failure, where particles of metal have been carried with the oil throughout the units of the transmission, it will be necessary to flush out the oil cooler and connecting lines. To flush the oil cooler and lines, use the following procedure:

1. Disconnect both cooler lines from the transmission.
2. Place a hose over the end of the cooler inlet line (from the bottom of the cooler) and insert the hose into an empty container.
3. Flush clean oleum solvent or equivalent through the return line (from the top of the cooler) using an oil suction gun until clean solvent comes out of the hose. This will "back flush" the cooler.
4. Remove the hose from the inlet cooler line and place it on the return line.
5. Flush clean oleum solvent or equivalent through the inlet line until clean solvent comes out the return line. Remove remaining solvent from cooler with compressed air applied to the return line and flush with transmission fluid.
6. Connect oil cooler lines and torque to specification.

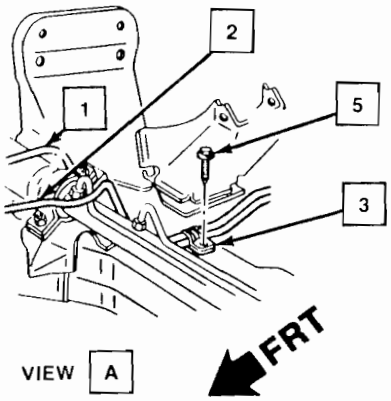
OIL FILTER

Replacement

1. Raise vehicle.
2. Remove the upper and lower underbody braces on vehicles equipped with a convertible top.
3. With drain pan placed under overdrive oil pan, remove oil pan attaching bolts from front and side of pan.
4. Loosen rear pan attaching bolts approximately four turns.
5. Carefully pry oil pan loose, allowing fluid to drain.
6. Remove remaining bolts and remove oil pan.
7. Drain fluid from oil pan. Clean pan with solvent and dry thoroughly with clean compressed air.
8. Remove filter from the transmission.
9. Install new filter.
10. Install the magnet in the oil pan as shown (Figure 7B-11). Apply a bead of R.T.V. Sealant #1052915 or equivalent to the oil pan flange and assemble wet. The bead of R.T.V. should be applied as shown in Figure 7B-11. Install bolts and torque to specifications.

NOTICE: The case and oil pan flange surfaces must be free of oil before applying R.T.V. sealant.

1. UPPER PIPE AT RADIATOR
   20-34 N·m (15-25 FT. LBS.)
2. LOWER PIPE AT RADIATOR
   20-34 N·m (15-25 FT. LBS.)
3. CLIP
4. BOLT
   10-14 N·m (8-10 FT. LBS.)
5. BOLT
   8-14 N·m (6-10 FT. LBS.)
6. BRACKET
7. BOLT
   8-14 N·m (6-10 FT. LBS.)
8. UPPER PIPE AT OVERDRIVE UNIT
   11-16 N·m (8-12 FT. LBS.)
9. LOWER PIPE AT OVERDRIVE UNIT
   11-16 N·m (8-12 FT. LBS.)



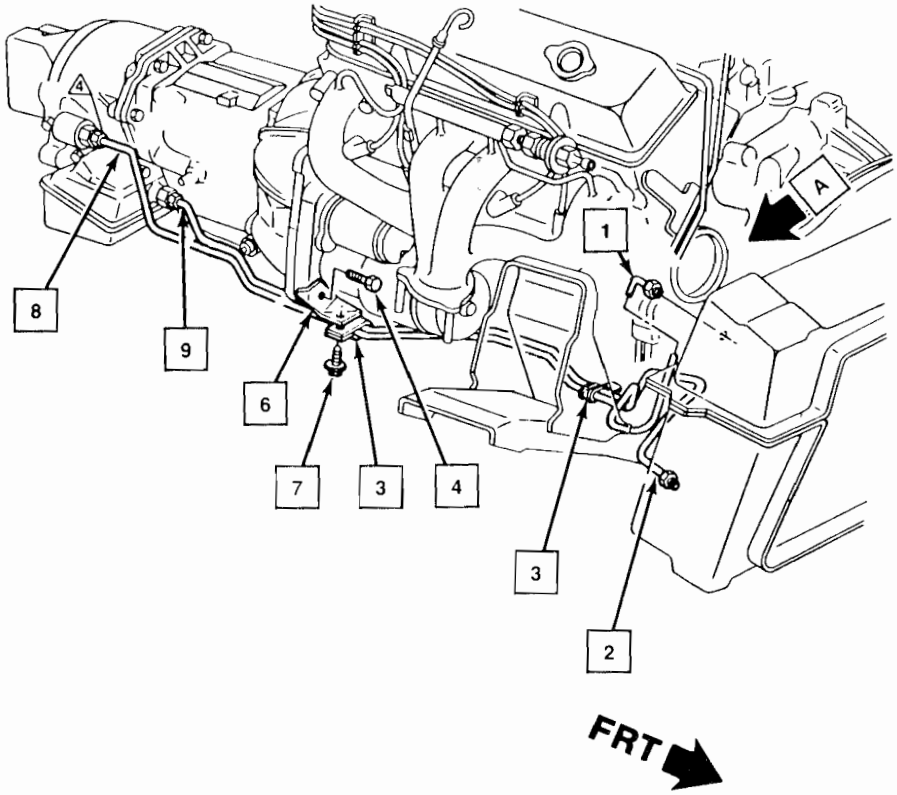
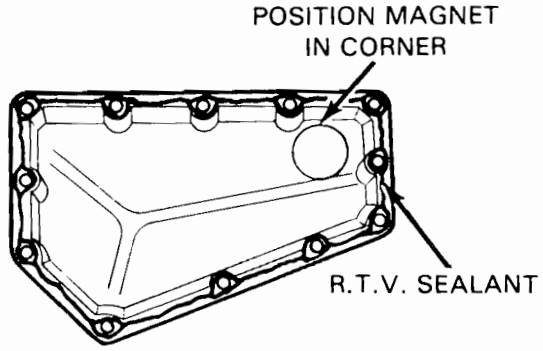


Figure 7B-10–Oil Cooler Lines



NOTE:

1. INSTALL THE OIL PAN ON HOUSING WHILE R.T.V. SEALANT IS WET.
   PAN AND HOUSING FLANGE SURFACE MUST BE DRY AND FREE OF OIL FILM.

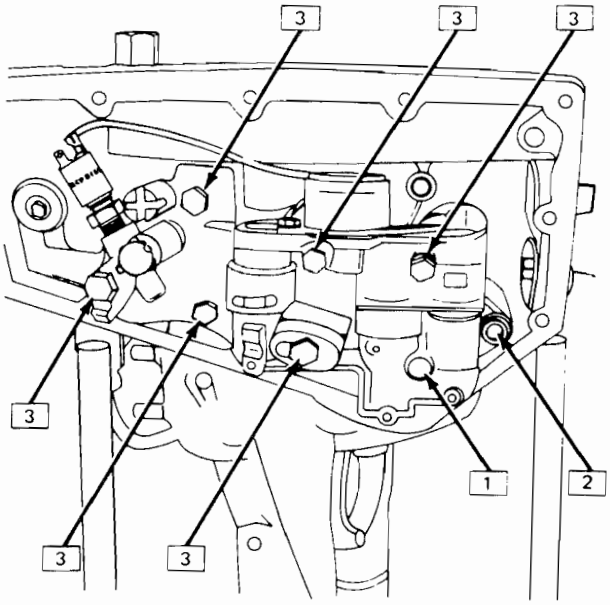
Figure 7B-11–Magnet and R.T.V. Location

11. Fill overdrive unit with Dexron II automatic transmission fluid.
12. Install the upper and lower underbody braces on vehicles equipped with a convertible top. Refer to the Body Section for installation and torque specifications.
13. Lower vehicle.

VALVE BODY (FIGURE 7B-12)

Removal and Installation

1. Remove the transmission oil pan and filter as previously outlined.



1. MACHINED ALLEN HEAD BOLT (1)
2. ALLEN HEAD BOLT (1)
3. BOLTS (6)
   TORQUE ALL BOLTS TO 8-10 N·m (6-8 FT. LBS.)

Figure 7B-12–Valve Body Attachments

2. Disconnect the tan electrical lead from the low pressure cut-off switch.
3. Remove the bolts attaching the valve body to the transmission case.
4. Remove the valve body with the spacer plate. Care must be taken to prevent loss of the (1) check ball located in the valve body. The check ball is spring loaded under the separator plate in the valve body.
5. Refer to the Overdrive Unit Repair Section for Disassembly and Inspection Procedures.
6. To install, reverse the removal procedures and include the following :
   - Apply a bead of R.T.V. Sealant #1052915 or equivalent to the oil pan flange as shown in Figure 7B-11.

NOTICE: The case and oil pan flange surfaces must be free of oil before applying R.T.V. sealant.

   - Fill overdrive unit with Dexron II automatic transmission fluid.
   - Install the upper and lower underbody braces on vehicles equipped with a convertible top. Refer to the Body Section for installation and torque specification.

OVERDRIVE SOLENOID (FIGURE 7B-14)

Replacement

1. Remove the transmission oil pan and filter as previously outlined.
2. Remove the valve body as previously outlined.
3. Using Tool J-34529, compress the shift valve spring and remove the pin.
4. Using Tool J-34529, compress the relief valve springs and remove the pin.
5. Remove the bolts attaching the solenoid valve to the valve body. Remove the solenoid and check ball from the valve body.
6. To install, reverse the removal procedures and include the following:
   - Apply a bead of R.T.V. Sealant #1052915 or equivalent to the oil pan flange as shown in Figure 7B-11.

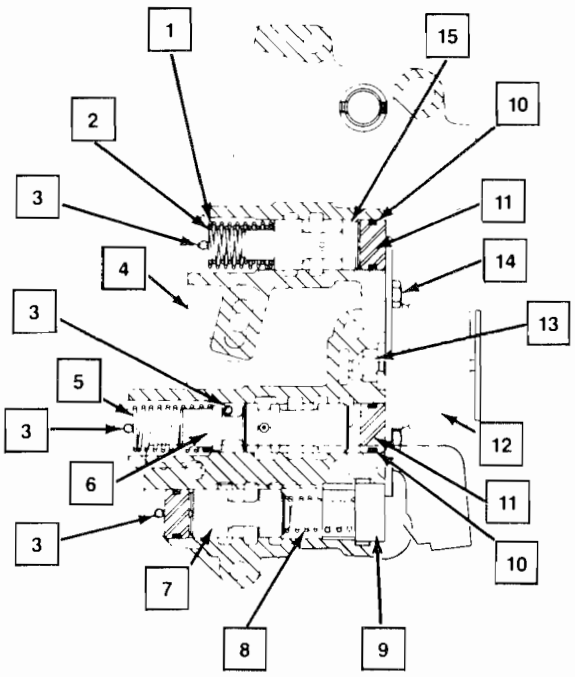
NOTICE: The case and oil pan flange surfaces must be free of oil before applying R.T.V. Sealant.

   - Fill overdrive unit with Dexron II automatic transmission fluid.
   - Install the upper and lower underbody braces on vehicles equipped with a convertible top. Refer to the Body Section for installation and torque specifications.

PRESSURE SWITCH (FIGURE 7B-14)

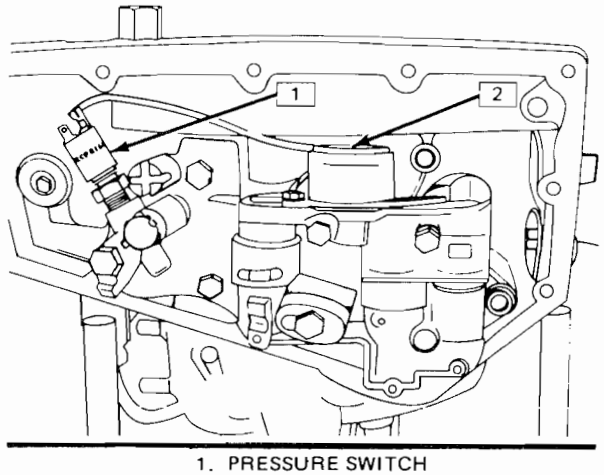
Replacement

1. Remove transmission oil pan as previously outlined.
2. Remove transmission oil filter.
3. Disconnect the (2) electrical leads at the switch.



1. OUTER RELIEF VALVE SPRING
2. INNER RELIEF VALVE SPRING
3. PIN
4. VALVE BODY
5. SHIFT VALVE SPRING
6. SHIFT SPOOL
7. T.V. MODULATOR SPOOL
8. T.V. MODULATOR SPOOL SPRING
9. SPRING SEAT
10. 'O' RING
11. END PLUG
12. SOLENOID
13. SOLENOID CHECK BALL
14. SOLENOID BOLT
15. RELIEF SPOOL

Figure 7B-13–Valve Body Components



1. PRESSURE SWITCH
2. O/D SOLENOID

Figure 7B-14–Pressure Switch and Overdrive Solenoid

4. Unscrew the switch from the valve body.

5. To install, reverse the removal procedures and include the following:
   - Apply a bead of R.T.V. Sealant #1052915 or equivalent to the oil pan flange as shown in Figure 7B-11.

   NOTICE: The case and oil pan flange surfaces must be free of oil before applying R.T.V. Sealant.

   - Fill overdrive unit with Dexron II automatic transmission fluid.
   - Install the upper and lower underbody braces on vehicles equipped with a convertible top. Refer to the Body Section for installation and torque specifications.

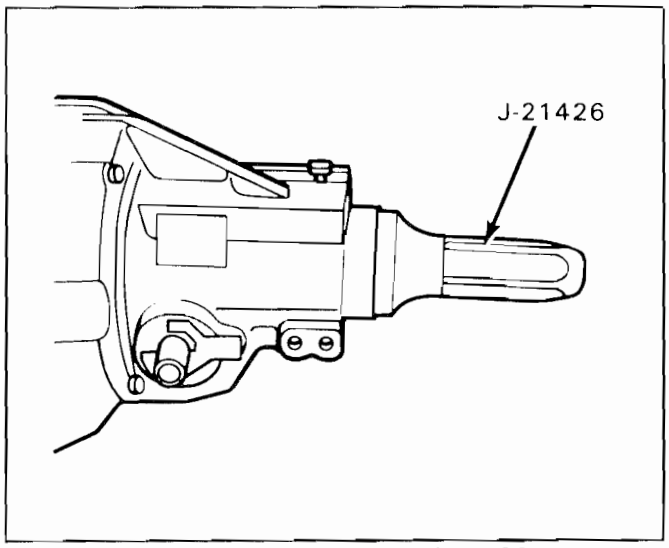


Figure 7B-15–Using Tool J-21426

OVERDRIVE UNIT OUTPUT SEAL (FIGURE 7B-15)

Replacement

1. Raise vehicle on hoist.
2. Remove the upper and lower underbody braces on vehicles equipped with a convertible top.
3. Remove the complete exhaust system as an assembly by:
   a. Disconnect A.I.R. pipe at the converter.
   b. Disconnect A.I.R. pipe clamps at exhaust pipe.
   c. Disconnect oxygen sensor electrical lead.
   d. Remove the exhaust hanger bolts at the driveline support beam.
   e. Remove the bolts attaching the mufflers to the hangers.
   f. Remove hanger bracket at the converter.
   g. Disconnect the exhaust from the exhaust manifolds and remove the exhaust system.
4. Support the transmission.
5. Remove the bolts attaching the driveline support beam at the axle and transmission. Remove driveline support beam from the vehicle as outlined in the Rear Suspension Section (3D).
6. Mark relationship of shaft to companion flange and disconnect the rear universal joint by removing trunnion bearing straps. Tape bearing cups to trunnion to prevent dropping and loss of bearing rollers.
7. Slid slip yoke from the transmission and remove shaft. Watch for oil leakage from transmission output shaft housing.
8. Pry out the old seal using a seal remover.
9. Using J-21426, place a new seal on the tool and install the seal. Coat the lip of the seal with automatic transmission fluid.
10. Install propeller shaft. Align propeller shaft with companion flange using reference marks established in "Removal" procedure, remove tape used to retain trunnion bearing caps, connect exposed bearing caps to companion flange. Torque retaining strap bolts to 17 N·m (150 in. lbs.).
11. Reverse the remaining removal procedures and include the following:
    - Refer to the Rear Suspension Section (3D) for driveline support beam installation, sealers and torque specifications.
    - Refer to the Exhaust System Section (6F) for installation and torque specifications.
    - Refer to Body Section for upper and lower underbody brace installation and torque specifications.

UNIT REPAIR (83MM)

TRANSMISSION (FIGURE 7B-1A)

Disassembly

1. Thoroughly clean the exterior of the transmission assemblies.
2. Remove the (7) bolts attaching the overdrive unit to the reverse housing and then separate the two transmission units (Figure 7B-2a).
3. Remove the drain plug from the lower right side of the case and drain the lubricant from the transmission.
4. Shift the transmission into second gear. Remove the shift cover attaching bolts, cover, gasket and both shift forks from the transmission.
5. Remove the backup switch from the reverse housing.

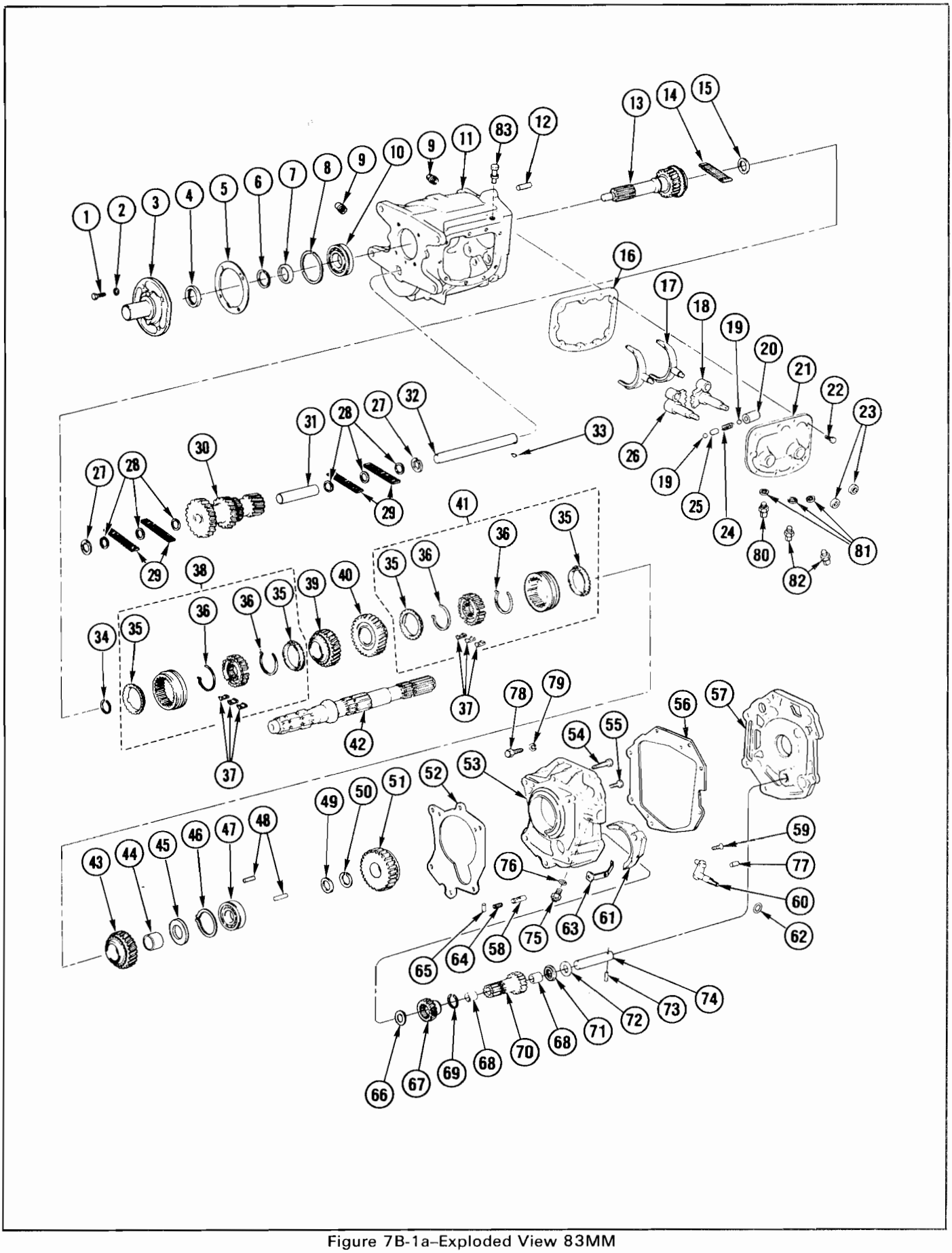


Figure 7B-1a–Exploded View 83MM

1. BOLT, Hex
2. WASHER, Ext. Lock
3. RETAINER, Main Dr. Gr. Brg. Frt.
4. SEAL, Main Dr. Gr. Brg. Frt. Oil
5. GASKET, Main Dr. Gr. Brg. Ret.
6. RING, Snap, Main Dr. Gr. Brg. Ret.
7. SPACER, Main Dr. G. Brg.
8. RING, Main Dr. Gr. Brg. Loc.
9. PLUG, Drain (Magnetic)
   PLUG, Sq. Hd. Fill
10. BEARING, Main Dr. Gr.
11. CASE, Trans.
12. PIN, Dowel
13. GEAR, Main Drive
14. ROLLER, Main Dr. Gr. Pilot Rr.
15. SPACER, Main Shf. Pilot Brg.
16. GASKET, Si. Cvr.
17. FORK, Shift (1-2, 3-4)
18. SHAFT, 1st & 2nd Shift
19. BALL, Steel
20. SLEEVE, Interlock
21. COVER, Side
22. BOLT, Trans. Cover
23. SEAL, Shft. Lvr. Shf. Oil (1-2, 3-4)
24. SPRING, Shft. Lvr. Poppet
25. PIN, Interlock
26. SHAFT, 3rd & 4th Shift
27. WASHER, Cntr. Gr. Rr.
28. WASHER, Cntr. Shf. Brg. Roller
29. ROLLER, Cntr. Gr. Brg.
30. GEAR, Cntr.
31. SPACER, Cntr. Gr. Brg.
32. SHAFT, Cntr. Gr.
33. KEY, Woodruff
34. RING, Snap, Main Shf.
35. RING, Sync. Blocking
36. SPRING, Sync.
37. KEY, Sync.
38. SYNCHRONIZER, 3rd & 4th
39. GEAR, 3rd Spd.
40. GEAR, 2nd Spd.
41. SYNCHRONIZER, 1st & 2nd
42. SHAFT, Main
43. GEAR, 1st Spd.
44. SLEEVE, 1st Spd. Gear
45. WASHER, 1st Spd. Gr. Thrust
46. RING, Snap, Rr. Brg. Loc.
47. BEARING, Main Shf. Rr.
48. PIN, Dowel
49. SPACER, Main Dr. Gr. Brg.
50. RING, Snap, Main Shf.
51. GEAR, Reverse
52. GASKET, Rr. Brg. Ret. to Trans. Case
53. RETAINER, Rr. Brg.
54. BOLT, Rr. Brg. Ret.
55. BOLT, Rr. Brg. Ret.
56. GASKET, Adapt. Plate
57. PLATE, Adapter
58. PIN, Rev. Detent
59. SCREW, Rr. Brg. Ret.
60. SHAFT, Rev. Shift
61. FORK, Rev. Shift
62. SEAL, Rev. Shft. Shf. Oil
63. BRACKET, TBI Harness Clip
64. SPRING, Rev. Detent Pin Poppet
65. PIN, Rev. Detent Spr.
66. WASHER, Frt. Rev. Idler Gr. Thrust
67. GEAR, Rev. Idler Frt
68. BUSHING, Rev. Idler
69. RING, Rev. Idler Gr. Ret.
70. GEAR, Rev. Idler Rr.
71. BEARING, Rev. Idler Thrust
72. WASHER, Rr. Rev. Idler Gr. Thrust
73. PIN, Spr.
74. SHAFT, Rev. Idler
75. SWITCH, Overdrive Override Rev. Gear
76. SEAL, Rev. Gr. Sw.
77. PIN, Solid Tapper
78. BOLT, Trans. to Overdrive
79. WASHER, Trans. to Overdrive Bolt Lk.
80. SWITCH, Overdrive Override (3-4)
81. SEAL, Overdrive Override Sw.
82. SWITCH, Overdrive Override (1-2)
83. VENTILATOR, Trans.

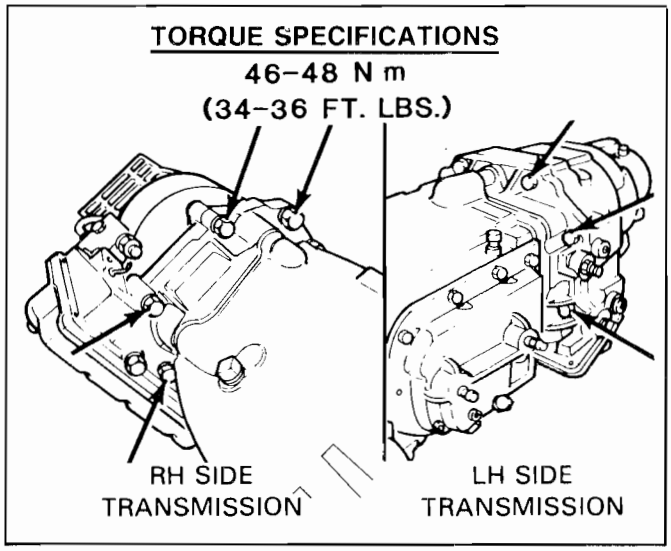


Figure 7B-2a–Reverse Housing to Overdrive Attachment

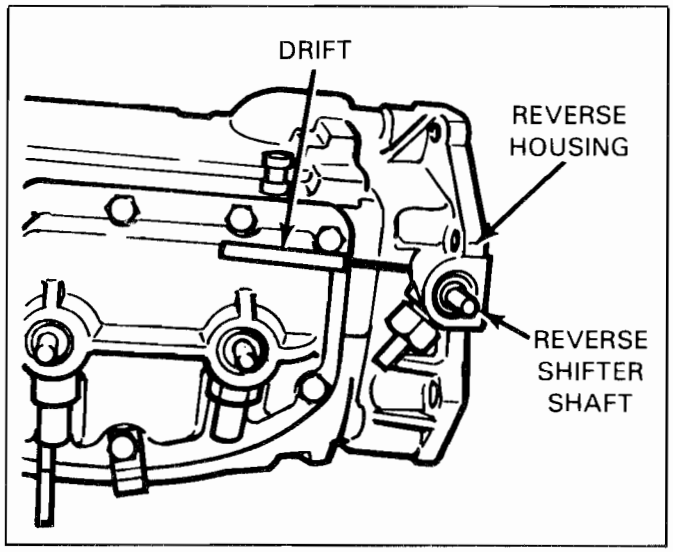


Figure 7B-4a–Reverse Shaft Lock Pin

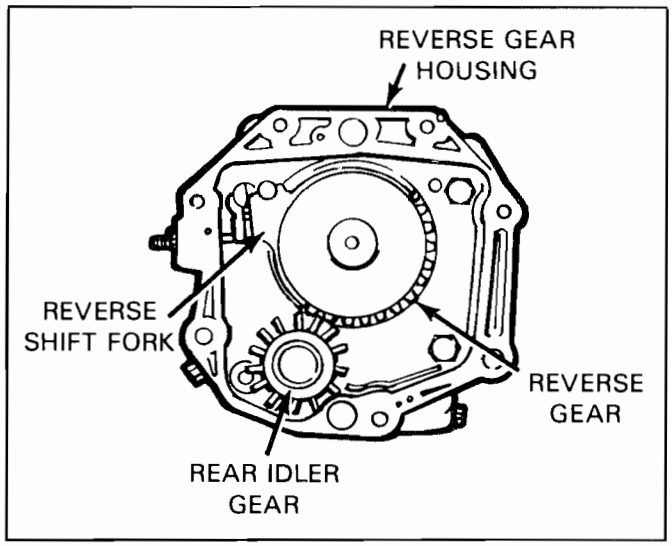


Figure 7B-3a–Reverse Gear and Shift Fork

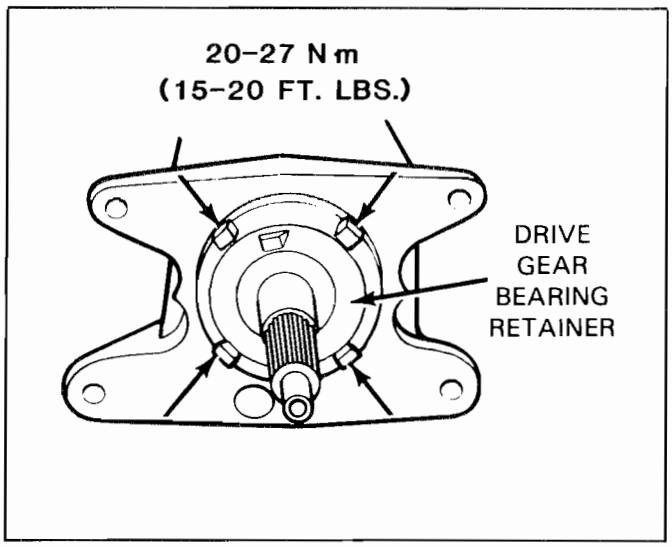


Figure 7B-5a–Drive Gear Bearing Retainer

6. Rotate the reverse shifter shaft and remove the shift fork and gear from the mainshaft (Figure 7B-3a).
7. Remove the lock pin from the reverse shift lever boss and pull the shaft from the housing (Figure 7B-4a).
8. Remove the drive gear bearing retainer bolts, retainer and gasket from the front of the transmission (Figure 7B-5a).
9. Remove front bearing snap ring, selective fit snap ring and spacer washer (Figure 7B-6a).
10. Using Tool J-6654-01 and J-8433-1, pull the drive gear bearing from the transmission (Figure 7B-7a).
11. Remove the (6) bolts attaching the reverse housing to the case. Using a small drift and a hammer, tap the locating pin for the reverse housing into the case (Figure 7B-8a).
12. Rotate the reverse housing on the mainshaft until the hole for the reverse idler gear shaft in the housing lines up with the countergear shaft (Figure 7B-9a).

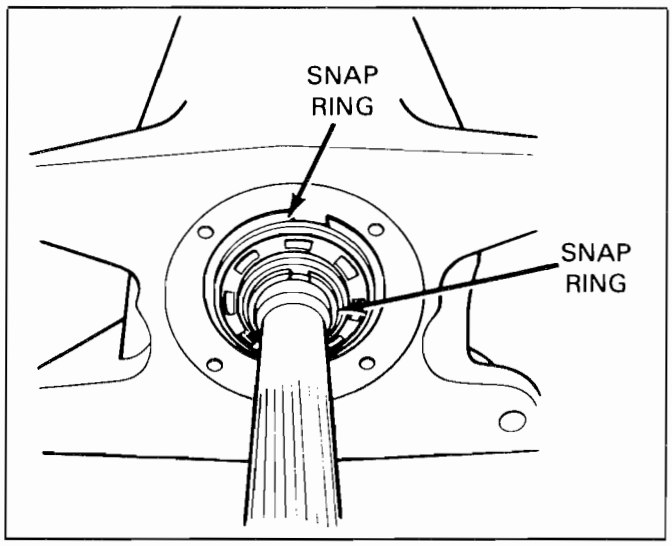


Figure 7B-6a–Front Bearing and Snap Ring

13. Using Tool J-24658 or a dummy shaft, drive the countergear shaft rearward out of the gear and

through the reverse housing (Figure 7B-10a). The countergear will drop to the bottom of the case allowing clearance for the removal of the mainshaft.

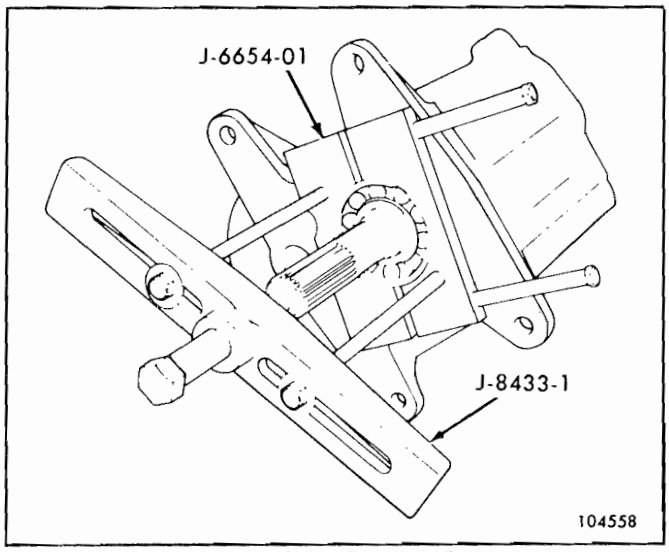


Figure 7B-7a–Front Bearing Removal

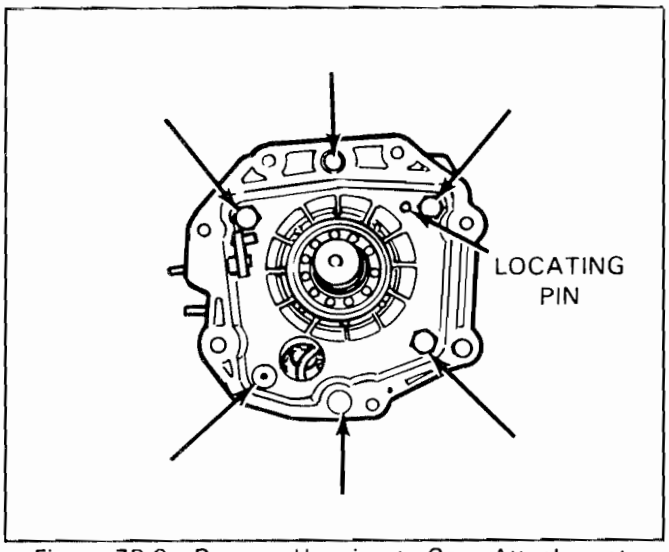


Figure 7B-8a–Reverse Housing to Case Attachment

14. Remove the mainshaft with the reverse housing and drive gear from the transmission case.
15. Remove the front reverse idler gear and thrust washer from the case.
16. Remove the countergear and two tanged thrust washers from the transmission case. Check the bottom of the transmission case for loose pilot bearings. Remove the locating pin for the reverse housing and any other loose components.

MAINSHAFT (FIGURE 7B-11A)

Disassembly

1. Using snap ring pliers, remove 3-4 synchronizer assembly retaining ring at front of mainshaft (Figure 7B-12a). Slide washer, synchronizer assembly, synchronizer ring 3rd speed gear from mainshaft.

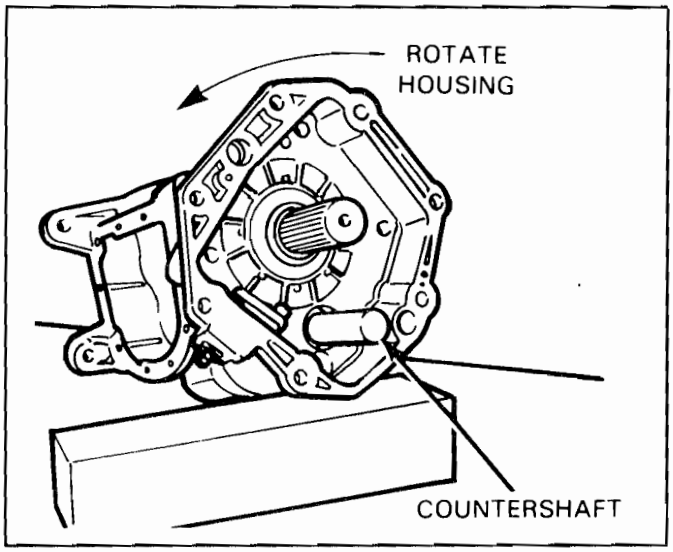


Figure 7B-9a–Countershaft Removal

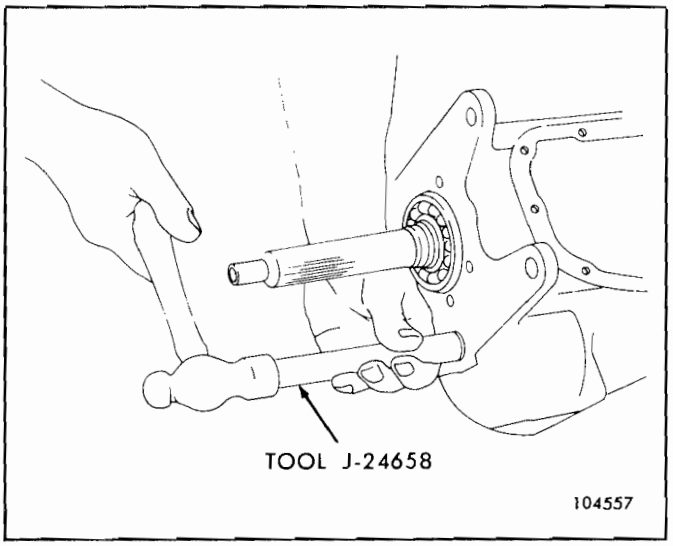


Figure 7B-10a–Tool J-24658

2. Spread rear bearing retainer snap ring (Figure 7B-13a) and slide retainer from mainshaft.
3. Remove rear bearing-to-mainshaft snap ring (Figure 7B-14a).
4. Support mainshaft under 2nd gear and press mainshaft from rear bearing, 1st gear and sleeve, 1-2 synchronizer assembly, and the second gear (Figure 7B-15a).

COUNTERGEAR (FIGURE 7B-16A)

Disassembly

1. Remove Tool J-24658 from the countergear.
2. Tip the countergear on end and let the (6) spacers, (112) rollers and roller sleeve slide out from the gear.

CLEANING AND INSPECTION

TRANSMISSION CASE

1. Wash the transmission thoroughly inside and outside with cleaning solvent, then inspect the case for cracks.

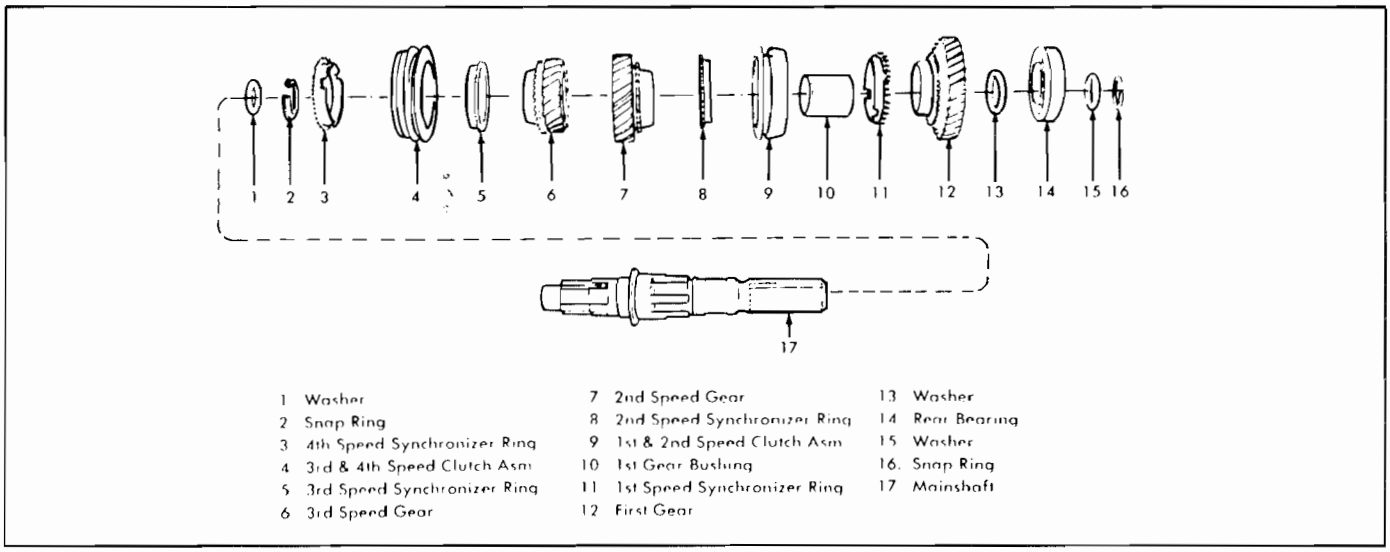


Figure 7B-11a–Mainshaft Exploded View

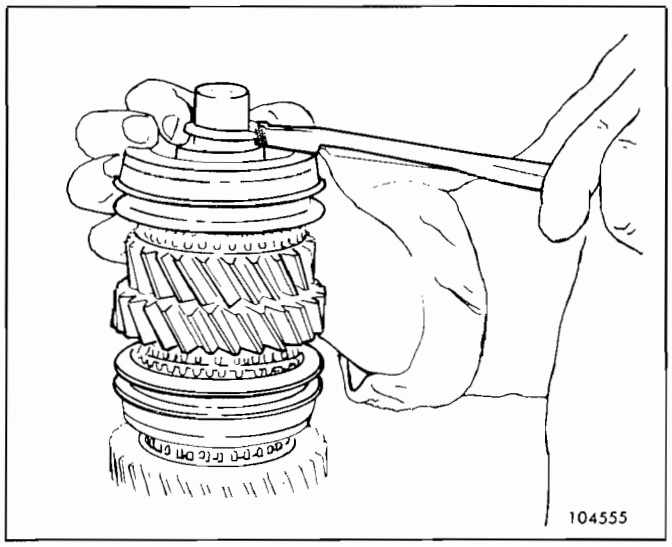


Figure 7B-12a–3-4 Synchronizer Retainer Snap Ring to Housing

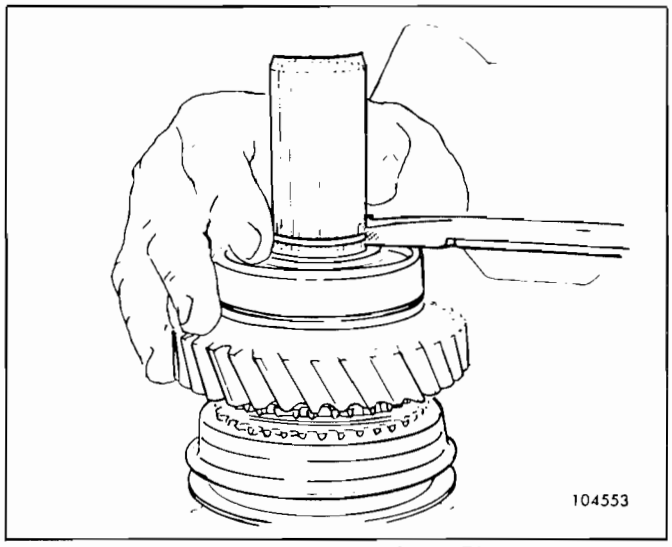


Figure 7B-14a–Rear Bearing Snap Ring to Shaft

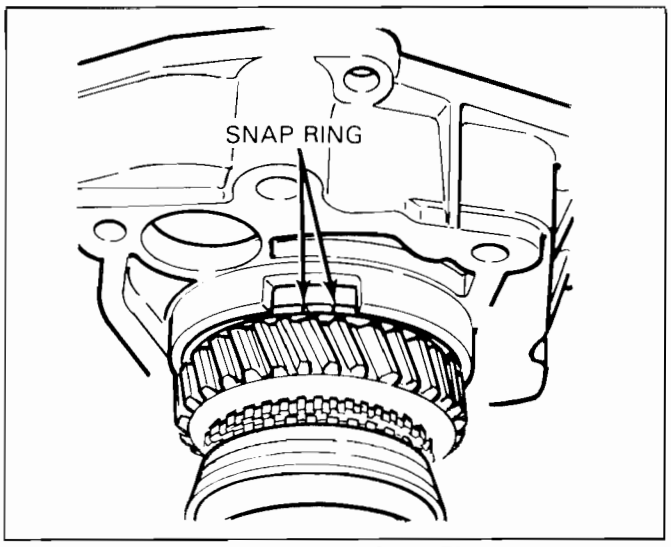


Figure 7B-13a–Rear Bearing Snap Ring to Housing

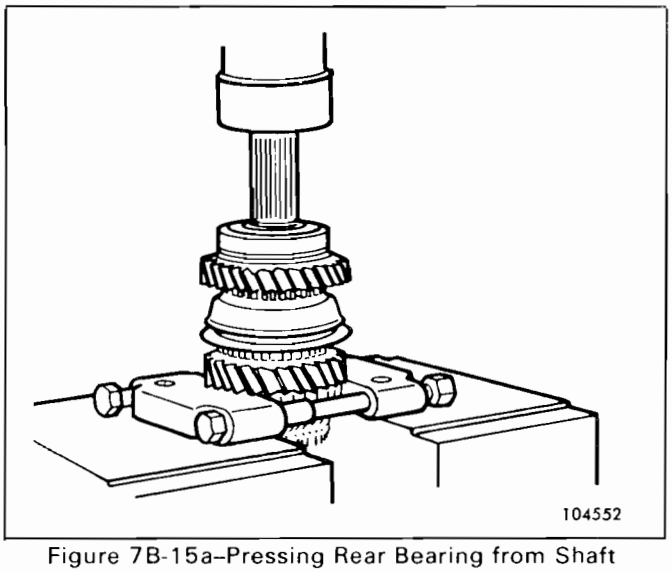


Figure 7B-15a–Pressing Rear Bearing from Shaft

2. Check the front and rear faces for burrs, and if present, dress them off with a fine mill file.

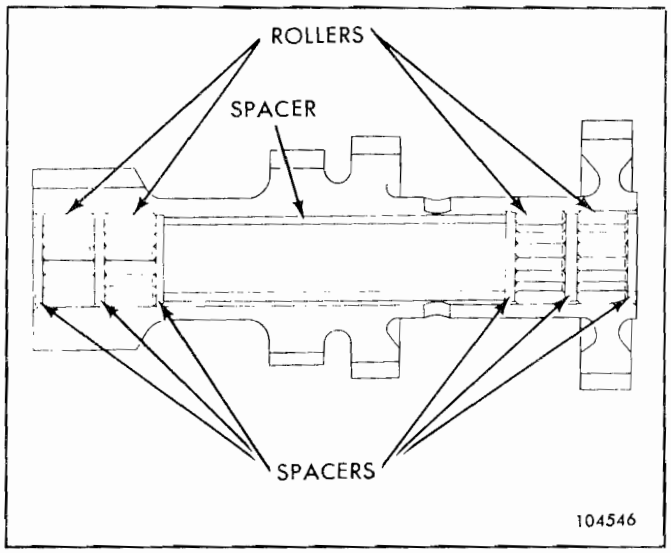


Figure 7B-16a–Countergear Cross Section

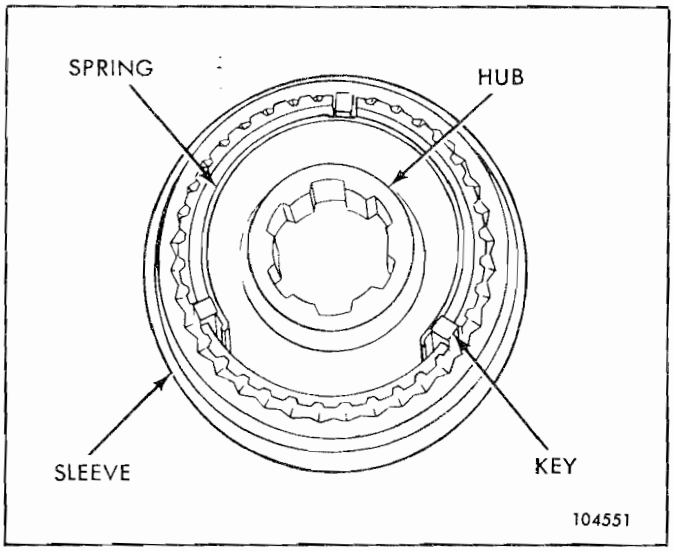


Figure 7B-17a–Synchronizer Assembly

Roller Bearings and Spacers

All main drive gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect countershaft and reverse idler shaft at the same time. Replace if necessary. Replace all worn spacers.

Gears

1. Inspect all gears for excessive wear, chips or cracks and replace any that are worn or damaged.
2. Inspect reverse gear bushing and if worn or damaged, replace the entire gear (reverse gear bushing is not serviced separately).
3. Check both synchronizer sleeves to see that they slide freely on their hubs.

Front and Rear Bearings

1. Wash the front and rear ball bearings thoroughly in a cleaning solvent.
2. Blow out bearing with compressed air.

NOTICE: Do not allow the bearing to spin. Turn them slowly by hand. Spinning bearings may damage the race and balls.

REPAIRS

SYNCHRONIZER KEYS AND SPRINGS

Replacement

The synchronizer hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and two springs may be replaced if worn or broken.

1. If relation of hub and sleeve are not already marked, mark for assembly purposes.
2. Push the hub from the sliding sleeve, the keys will fall free and the springs may be easily removed.
3. Place the two springs in position (one on each side of hub) so all three keys are engaged by both spring.

Place the keys in position and while holding them in place, slide the sleeve onto the hub, aligning the marks made before disassembly.

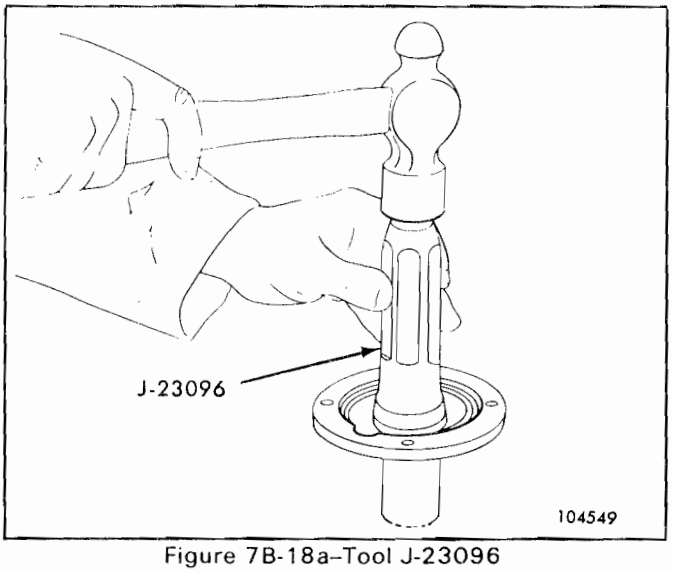


Figure 7B-18a–Tool J-23096

DRIVE GEAR BEARING RETAINER OIL SEAL

Replacement (Figure 7B-18a)

1. Pry out old seal.
2. Using a new seal, install new seal into retainer using Tool J-23096 until it bottoms in bore (Figure 7B-18a). Lubricate I.D. of seal with transmission lubricant.

REVERSE SHIFTER SHAFT AND/OR SEAL

Replacement

1. With the reverse housing removed from transmission, the reverse shifter shaft lock pin will already be removed.
2. Carefully drive shifter shaft into the reverse housing allowing ball detent to drop into case. Remove shaft and ball detent spring. Remove "O" ring seal from shaft.

3. Place ball detent spring into detent spring hole and start reverse shifter shaft into hole in boss.
4. Place detent ball on spring and while holding ball down, push the shifter shaft into place and turn until the ball drops into place in detent on the shaft detent plate.
5. Install "O" ring seal on shaft.
6. Install shift fork. Do not drive the shifter shaft lock pin into place until the reverse housing has been installed on the transmission case.

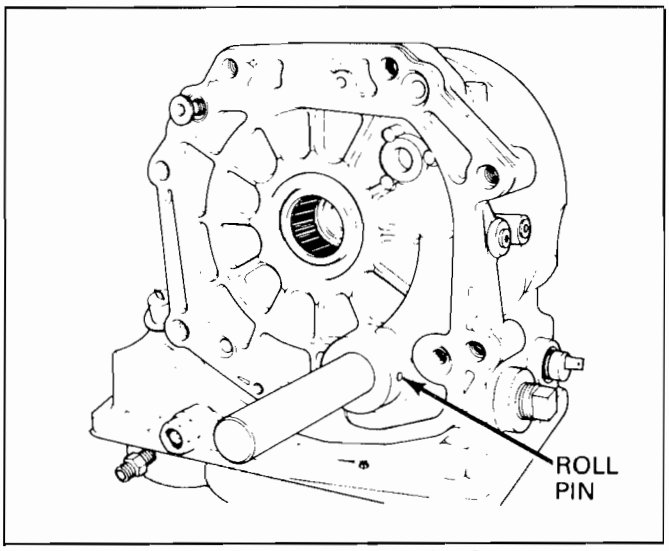


Figure 7B-19a–Reverse Idler Shaft

REVERSE IDLER SHAFT (FIGURE 7B-19A)

Replacement

1. Place a small punch into hole in front cover of the overdrive unit and drive the pin into the shaft (Figure 7B-19a) until the shaft can be pulled from front cover.
2. Insert new idler shaft into cover until hole in shaft lines up with hole in boss.
3. Insert a new roll pin into boss opening and drive the pin into the cover until flush with surface of the boss.

TRANSMISSION SIDE COVER (FIGURE 7B-20A)

1. Remove the outer shifter lever nuts and lockwasher and pull levers from shafts.
2. Carefully push the shifter shafts into cover, allowing the detent balls to fall free, then remove both shifter shafts.
3. Remove interlock sleeve, interlock pin and poppet spring.
4. Replace necessary parts and assembly by reversing Steps 1-3.
5. Check the interlock sleeve clearances as follows:
   a. Position the 1st/2nd gear shifter shaft in the neutral detent. Rotate the 3rd/4th gear shifter shaft aganist the 3rd gear stop. Place a feeler gage between the interlock sleeve and the stop as shown in Figure 7B-21a and measure the clearance.
      - Specification - .001" to .004"

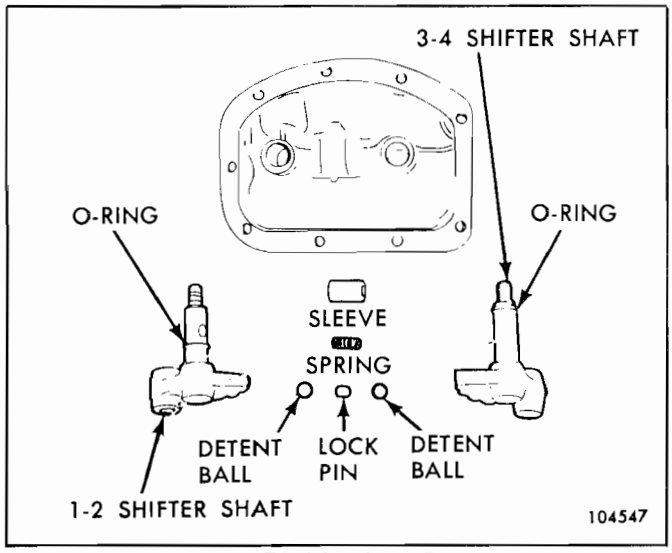


Figure 7B-20a–Side Cover

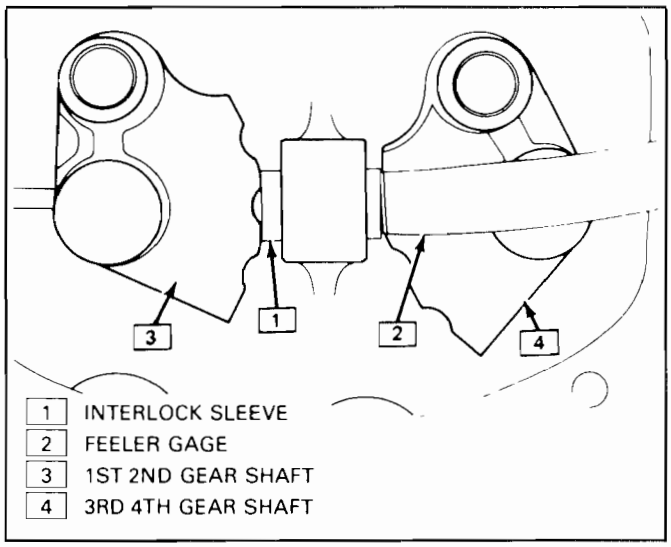


Figure 7B-21a–Measuring Interlock Sleeve Clearance

   b. With the 1st/2nd gear shifter shaft in the neutral detent, rotate the 3rd/4th gear shifter shaft against the 4th gear stop. Place a feeler gage between the interlock sleeve and the stop and measure the clearance.
      - Specification - .007" max.
   c. Position the 3rd/4th gear shifter shaft in the neutral detent. Rotate the 1st/2nd gear shifter shaft against the 1st gear stop. Place a feeler gage between the interlock sleeve and the 1st gear stop and measure the clearance.
      - Specification - .007" max.
   d. With the 3rd/4th gear shifter shaft in the neutral detent, rotate the 1st/2nd gear shifter shaft against the 2nd gear stop. Place a feeler gage between the interlock sleeve and the stop and measure the clearance.
      - Specification - .007" max.

If any of the above measurements are not within the specification shown, replace the interlock sleeve.

The interlock sleeve is available in 12 sizes in .0015" increments.

COUNTERGEAR

Assembly

1. Install roller spacer in countergear (if removed).
2. Insert a dummy shaft or loading Tool J-24658 into countergear.
3. Using heavy grease to retain rollers, install spacer, 28 rollers, spacer, 28 rollers, and spacer in either end of countergear. Repeat in other end of countergear.

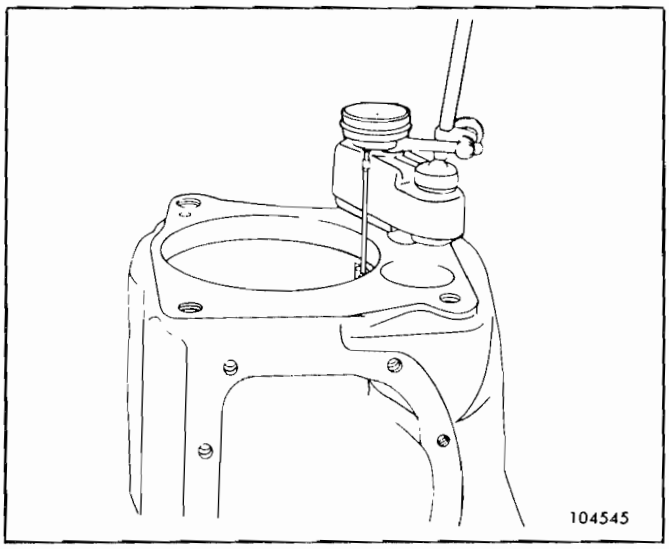


Figure 7B-22a–Measuring Countergear End Play

Checking Countergear End Play

1. Rest the transmission case on its side with the side cover opening toward the assembler. Put countergear tanged thrust washers in place, retaining them with heavy grease, making sure the tangs are resting in the notches of the case.
2. Set countergear in place in bottom of transmission case, making sure that tanged thrust washers are not knocked out of place.
3. Position the transmission case resting on its front face.
4. Lubricate and insert countergear (pushing loading Tool J-24658 out front of case) until woodruff key slot is in its relative installed position (do not install key).
5. Attach a dial indicator as shown in Figure 7B-22a and check end play of the countergear. If end play is greater than .025", new thrust washers must be installed.

MAINSHAFT (FIGURE 7B-11A)

Assembly

1. From rear of mainshaft, assemble the 2nd speed gear (with hub of gear toward rear of shaft).
2. Install 1st-2nd synchronizer assembly (sliding synchronizer sleeve taper toward rear, hub to front) on the mainshaft together with a synchronizer ring on both sides of the synchronizer assemblies.
3. Position the 1st gear sleeve on the shaft and press the sleeve onto the mainshaft until the 2nd gear, synchronizer assembly and sleeve bottom against the shoulder of the mainshaft (Figure 7B-23a).
4. Install 1st speed gear (with hub toward front) and supporting inner race, press the rear bearing onto the mainshaft with the snap ring groove toward front of the transmission (Figure 7B-24a).
5. Install spacer and new correct selective fit (thickest that will assemble) snap ring in mainshaft behind rear bearing.
6. Install the 3rd speed gear (hub to front of transmission) and the 3rd speed gear synchronizing ring (notches to front of transmission).
7. Install the 3rd and 4th speed gear synchronizer assembly (hub and sliding sleeve) with taper toward the front making sure that the keys in hub correspond to the notches in the 3rd speed gear synchronizing ring.

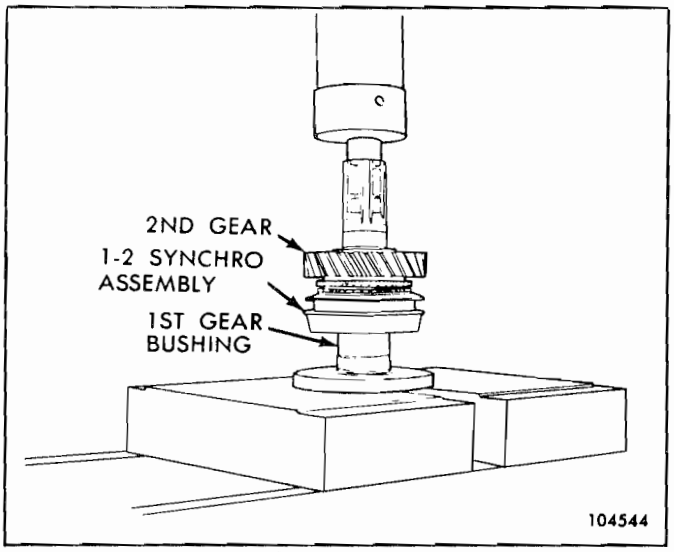


Figure 7B-23a–1st Gear Sleeve

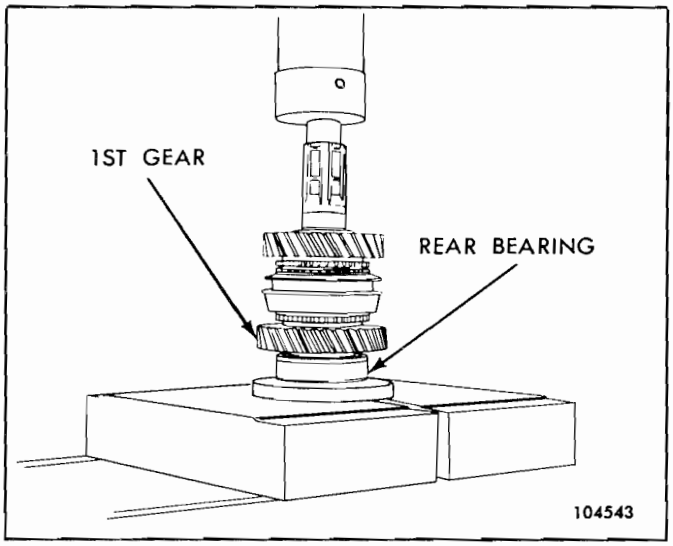


Figure 7B-24a–Rear Bearing

8. Install new selective fit snap ring (thickest that will install) in the groove in mainshaft in front of the 3rd and 4th speed synchronizer assembly.
9. Install the rear bearing retainer (reverse housing) over end of mainshaft. Spread the snap ring to drop around the rear bearing. Relase snap ring when it aligns with groove in rear bearing.

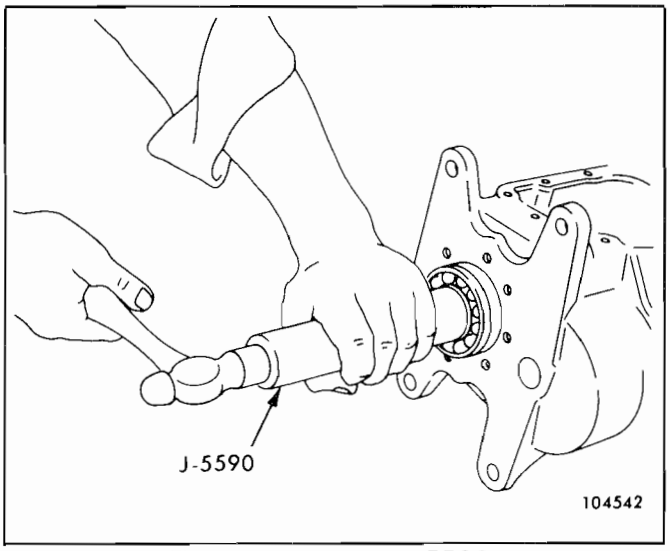


Figure 7B-25a–Tool J-5590

TRANSMISSION

Assembly

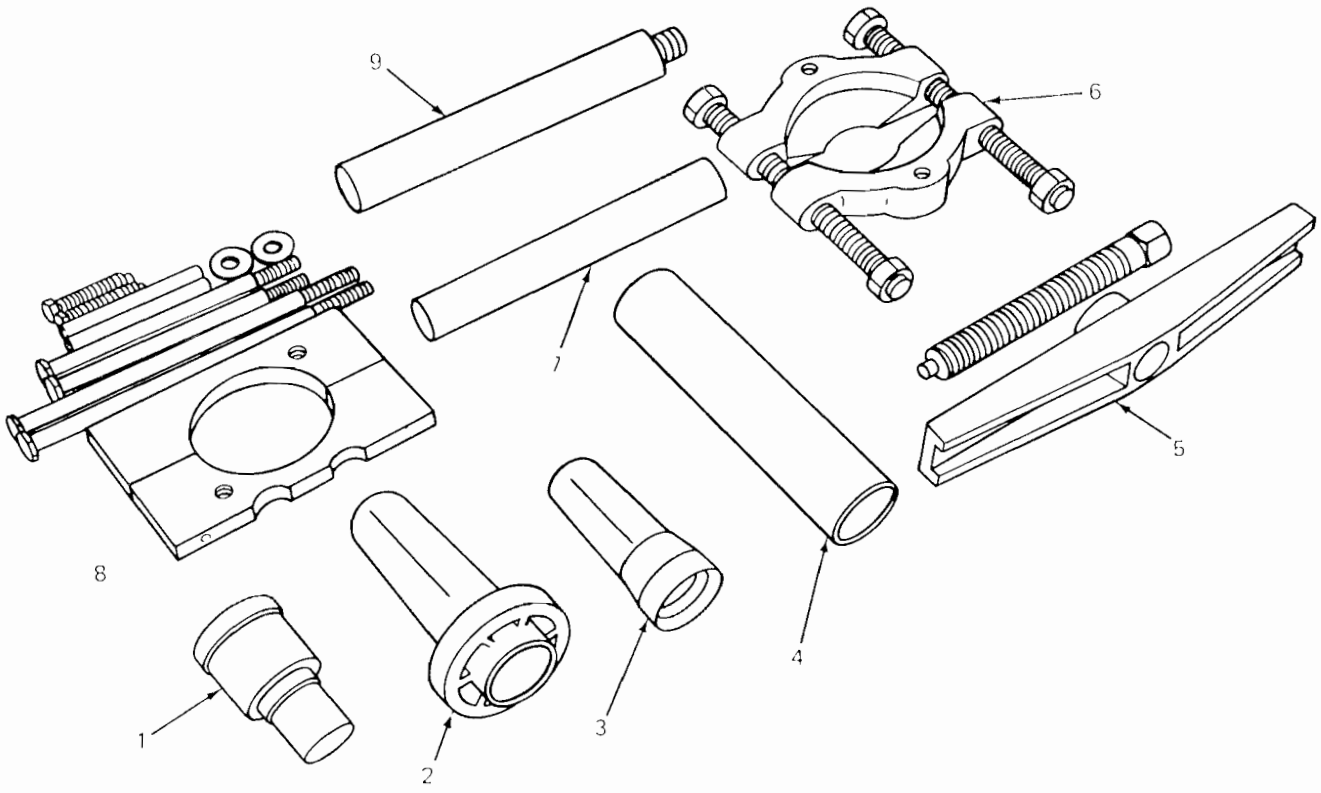
1. Place the transmission case on its side with the shift cover opening toward the assembler. Position the countergear tanged washers in place, using a heavy grease to retain them.

   NOTICE: Be sure the tangs are in the notches of the thrust face.

2. Position the countergear in the bottom of the case.
3. Install front reverse idler gear (teeth forward) and thrust washer in case. Use a heavy grease to hold thrust washer in position.
4. Using a heavy grease, install sixteen (16) roller bearings and washer into main drive gear. Mate main drive gear with mainshaft assembly. Position 3rd-4th synchronizer sliding sleeve forward. This will provide clearance for installation as well as hold the assembly together.
5. Position a new reverse housing to case gasket on the rear of the case.
6. Install the mainshaft and drive gear assembly into the case.
7. Place bearing snap ring on front main bearing. Position front main bearing to case opening and with a hollow shaft, or Tool J-5590, tap bearing into case (Figure 7B-25a). Install spacer washer and selective fit snap ring to secure main drive bearing.
8. Raise the countergear in the case, aligning the holes in the case with the center of the gear. With the thrust washers in place, slide the counter shaft through the rear of the case. Install the woodruff key and tap the shaft into the case, until flush with the rear face of the transmission case.
9. Align the reverse housing and gasket to the transmission case. Install the locating pin for the reverse housing. Tap the pin in until flush with housing.
10. Install the (6) bolts attaching the reverse housing to the case. Torque bolts to specifications.
11. Install the reverse shift shaft and "O" ring into the housing. Install retaining pin.
12. Install the reverse gear and shift fork. Slide the gear and fork forward on the mainshaft until shift fork and shifter shaft can be indexed into position.
13. Position the drive gear bearing retainer and gasket to the front of the case. Apply sealer to the bolts. Install bolts and torque to specifications.
14. Install the rear reverse idler gear. Align the splines on the rear gear with the front gear and slide together.
15. Assemble the overdrive unit to the reverse housing. Guide the idler shaft on the O/D unit into the idler gears and align the splines on the mainshaft with the splines in the input sun gear. Slide the units together and install the retaining bolts. Torque the bolts to specifications.
16. Slide the 1-2 synchronizer forward into second gear. Install the shift forks into the grooves of the synchronizers. Place the side cover with a gasket on the transmission. Guide the shift forks into the cover and install the retaining bolts. Torque the bolts to specifications.
17. Check operation of transmission by manually shifting the transmission into all gears.

DRIVE GEAR BEARING RETAINER BOLTS	20-27 N·m	15-20 FT. LBS.
SIDE COVER TO CASE BOLTS	20-27 N·m	15-20 FT. LBS.
REVERSE GEAR HOUSING TO CASE (1) BOLT	40-54 N·m	30-40 FT. LBS.
REVERSE GEAR HOUSING TO CASE (2) BOLTS	54-67 N·m	40-50 FT. LBS.
REVERSE GEAR HOUSING TO CASE (3) BOLTS	47-61 N·m	35-45 FT. LBS.
DRAIN PLUG	20-33 N·m	15-25 FT. LBS.
FILLER PLUG	33-47 N·m	25-35 FT. LBS.
TRANSMISSION TO BELL HOUSING BOLTS	60-80 N·m	45-60 FT. LBS.

Figure 7B-26a–Specifications



1. J-23062-14 EXTENSION HOUSING BUSHING REMOVER/INSTALLER
2. J-21426 EXTENSION HOUSING SEAL INSTALLER
3. J-23096 DRIVE GEAR RETAINER SEAL INSTALLER
4. J-5590 FRONT BEARING INSTALLER
5. J-8433 BEARING PULLER
6. J-22912-01 BEARING PULLER
7. J-24658 COUNTERGEAR LOADING TOOL
8. J-6654-01 FRONT BEARING REMOVER
9. J-8092 DRIVER HANDLE

Figure 7B-27a–Special Tools

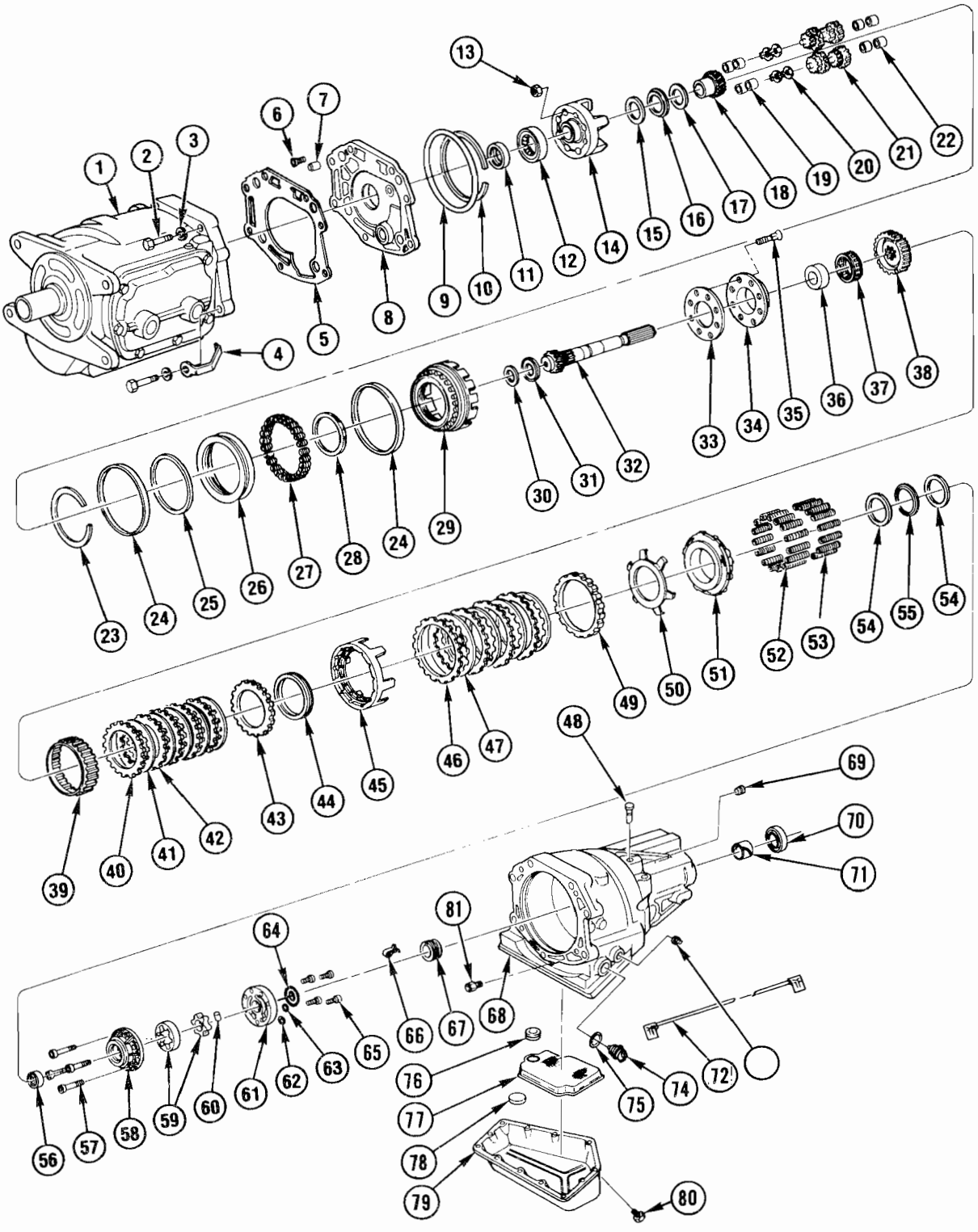
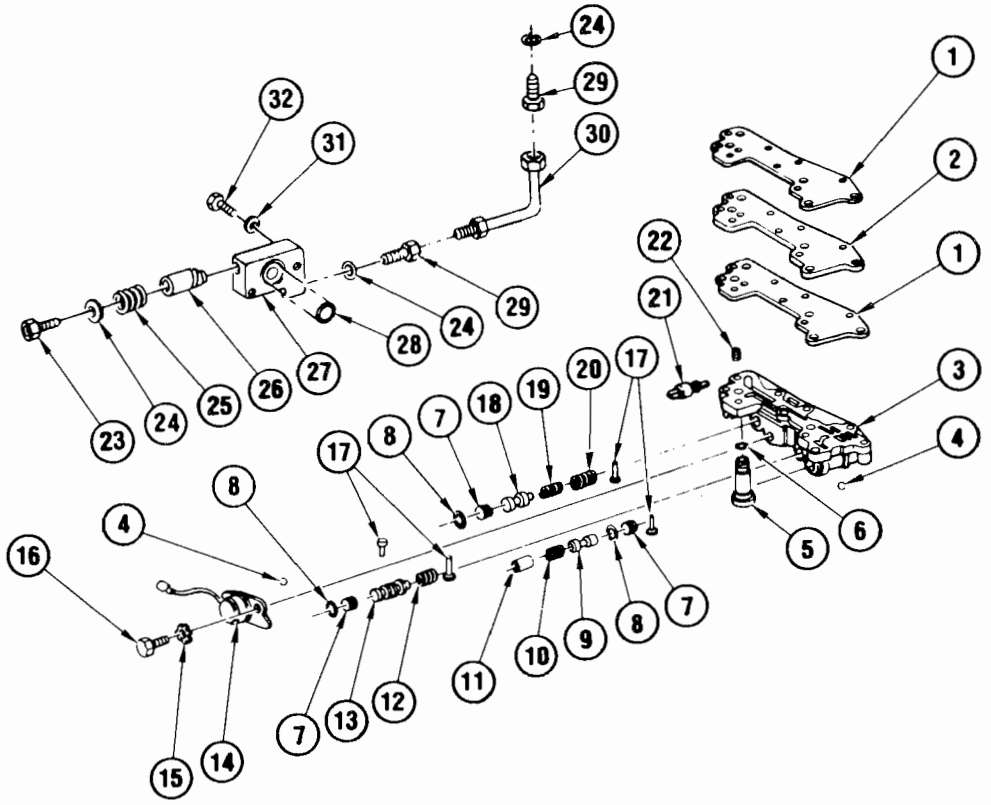


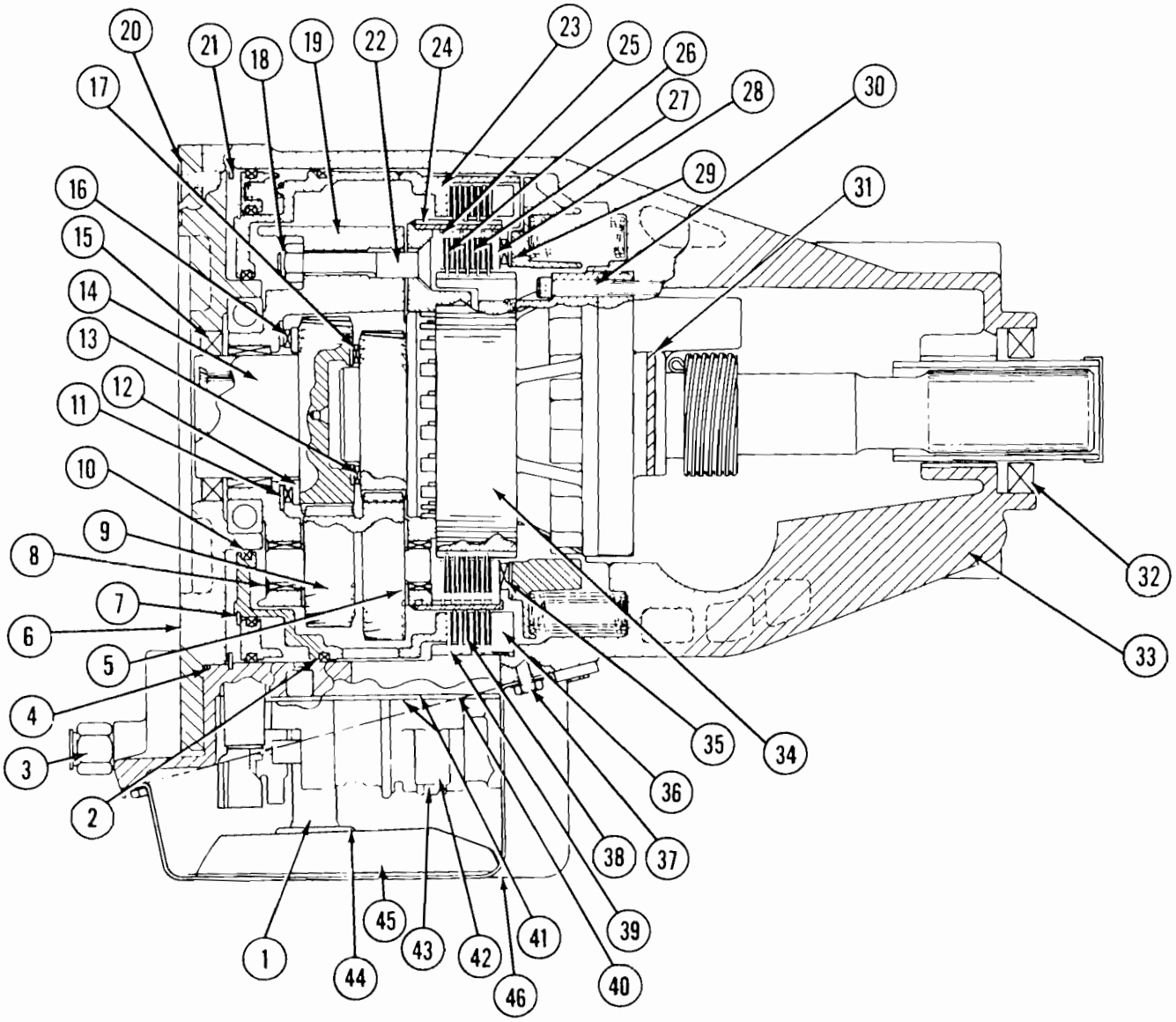
Figure 7B-1b–Exploded View (Overdrive Unit)

1. TRANSMISSION (Less Overdrive Unit)
2. BOLT, Trans. to Overdrive
3. WASHER, Trans. to Overdrive Bolt Lk.
4. BRACKET, TBI Harness Clip
5. GASKET, Adapter Plate
6. SCREW, Adapter Plate
7. PIN, Dowel
8. PLATE, Adapter
9. "O" RING, Adapter Plt.
10. RING, Accum. Piston Ret.
11. SEAL, Input Sun Gr. Oil
12. BEARING, Annular
13. NUT, Carrier Brg. Lk.
14. CARRIER, Planetary Gear
15. WASHER, Input Sun Gr. Thrust
16. BEARING, Input Sun Gr. Thrust
17. WASHER, Input Sun Gr. Thrust (Selective)
18. GEAR, Input Sun
19. CUP, Brg.
20. WASHER, Planetary Gr. Thrust
21. GEAR, Planetary
22. CUP, Brg.
23. RING, Accum. Piston Ret.
24. SEAL, Accum. Piston
25. SEAL, Accum. Piston
26. PISTON, Accum. Cushion
27. SPRING, Accum. Piston
28. SEAL, Accum. Piston
29. PISTON, Accum.
30. WASHER, Otpt. Shf. Thrust
31. BEARING, Otpt. Shf. Trust
32. SHAFT, Otpt.
33. PLATE, Planetary Gear Thrust
34. PLATE, Clu. Drum
35. BOLT, Clu. Drum
36. RACE, Inner
37. SPRAG, Dir. Clu.
38. HUB, Dir. Clu.
39. DRUM, Dir. Clu
40. PLATE, Dir. Clu. Inr. Driven (Selective)
41. PLATE, Dir. Clu. (6)
42. PLATE, Dir. Clu. Driven (6)
43. PLATE, Dir. Clu. Press
44. BEARING, Dir. Clu.
45. PISTON, Overdrive Clu.
46. PLATE, Overdrive Clu. Driven (5)
47. PLATE, Overdrive Clu. (5)
48. TUBE, Overdrive Vent
49. PLATE, Overdrive Clu. Press
50. WASHER, Dir. Clu. Thrust
51. PISTON, Overdrive Dir. Clu.
52. SPRING, Overdrive Dir. Clu. Otr.
53. SPRING, Overdrive Dir. Clu. Inr.
54. WASHER, Overdrive Dir. Clu. Hub Thrust
55. BEARING, Overdrive Dir. Clu. Hub Thrust
56. CUP, Pump Brg.
57. SCREW, Overdrive Pump & Otpt. Shf.
58. HOUSING, W/Brg., Overdrive Pump (Gerotor)
59. PUMP, Overdrive Oil (Gerotor)
60. PIN, Oil Pump Drive
61. COVER, Pump (Gerotor)
62. "O" RING, Overdrive Oil Pump
63. "O" RING, Overdrive Oil Pump
64. SEAL, Pump
65. SCREW, Overdrive Pump Spool (Gerotor)
66. CLIP, Speedo Drive Gr.
67. GEAR, Speedo Drive
68. CASE, Overdrive
69. PLUG, Headless Slotted
70. SEAL, Overdrive Otpt. Shf. Oil
71. BUSHING, Case
72. WIRE, Overdrive Vlv. Body Press Sw.
73. PLUG, Sq. Hd. Filler
74. CONNECTOR, Overdrive Sol. Elec.
75. "O" RING, Overdrive Sol. Elec. Conn.
76. GROMMET, Overdrive Oil Screen Tube
77. SCREEN, Overdrive Oil
78. MAGNET, Overdrive Oil Pan
79. PAN, Overdrive Oil
80. BOLT, Overdrive Oil Pan
81. FITTING, Oil Cooler



1. GASKET, Overdrive Valve Body
2. PLATE, Overdrive Valve Body Spacer
3. BODY ASSEMBLY, Overdrive Valve
4. BALL, Steel
5. TUBE, Overdrive Oil Screen
6. "O" RING, Overdrive Oil Screen Tube
7. PLUG, End
8. "O" RING, Overdrive Oil Pump
9. SPOOL, Modulator
10. SPRING, Modulator
11. SPRING SEAT
12. SPRING, Shift
13. SPOOL, Shift
14. SOLENOID, Overdrive Valve Body
15. WASHER, Overdrive Valve Body Solenoid Bolt
16. BOLT, Overdrive Valve Body Solenoid
17. PIN
18. SPOOL, Relief
19. SPRING, Inner Relief
20. SPRING, Outer Relief
21. SWITCH, Press Overdrive Valve Body
22. SPRING, Overdrive Piston Exh. Chk. Valve Ball
23. CONNECTOR, Overdrive Oil Cooler By-Pass
24. "O" RING, Overdrive Oil Cooler Valve Conn.
25. SPRING, Overdrive Oil Cooler Chk. Valve
26. SPOOL, Cooler Valve
27. VALVE, Overdrive Oil Cooler
28. "O" RING, Overdrive Oil Cooler Valve
29. FITTING, Oil Cooler
30. TUBE, Overdrive Oil Cooler
31. WASHER, Overdrive Oil Cooler Valve Bolt Lk.
32. BOLT, Overdrive Oil Cooler Valve

Figure 7B-2b Exploded View (Valve Body)



1. PICKUP TUBE
2. SEAL, "QUAD"
3. FITTING
4. SEAL, 'O' RING
5. PLATE, THRUST
6. PLATE, ADAPTOR
7. PISTON-ACCUM. ASS'Y
8. WASHER, THRUST
9. GEAR, PLANET
10. SEAL, "QUAD"
11. WASHER, THRUST
12. WASHER, THRUST
13. WASHER, THRUST
14. GEAR, SUN
15. SEAL, INPUT
16. BEARING, THRUST
17. BEARING, THRUST
18. NUT, LOCK
19. CARRIER-BRG. ASS'Y
20. SCREWS, C.S.
21. RING, RETAINING
22. SCREWS, C.S.
23. PLATE, FINGER PRES.
24. CLUTCH HUB ASS'Y
25. PLATE, SEL. CLUTCH
26. DISC, CLUTCH (6)
27. PLATE, CLUTCH (6)
28. PLATE, BEARING
29. WASHER, THRUST
30. SCREW, ALLEN 6m x 40mm
31. SEAL, PUMP
32. SEAL, OUTPUT
33. HOUSING ASS'Y
34. SHAFT ASS'Y
35. BEARING, THRUST
36. CLUTCH, STOP
37. SCREW, 6m x 12mm lg.
38. DISC, CLUTCH (5)
39. PLATE, CLUTCH (5)
40. PLATE, VALVE
41. GASKET, VALVE
42. VALVE BODY ASS'Y
43. SCREW, HEX. 6m x 45mm
44. GROMMET
45. OIL FILTER
46. OIL PAN

Figure 7B-3b–Cross Section View (Overdrive Unit)

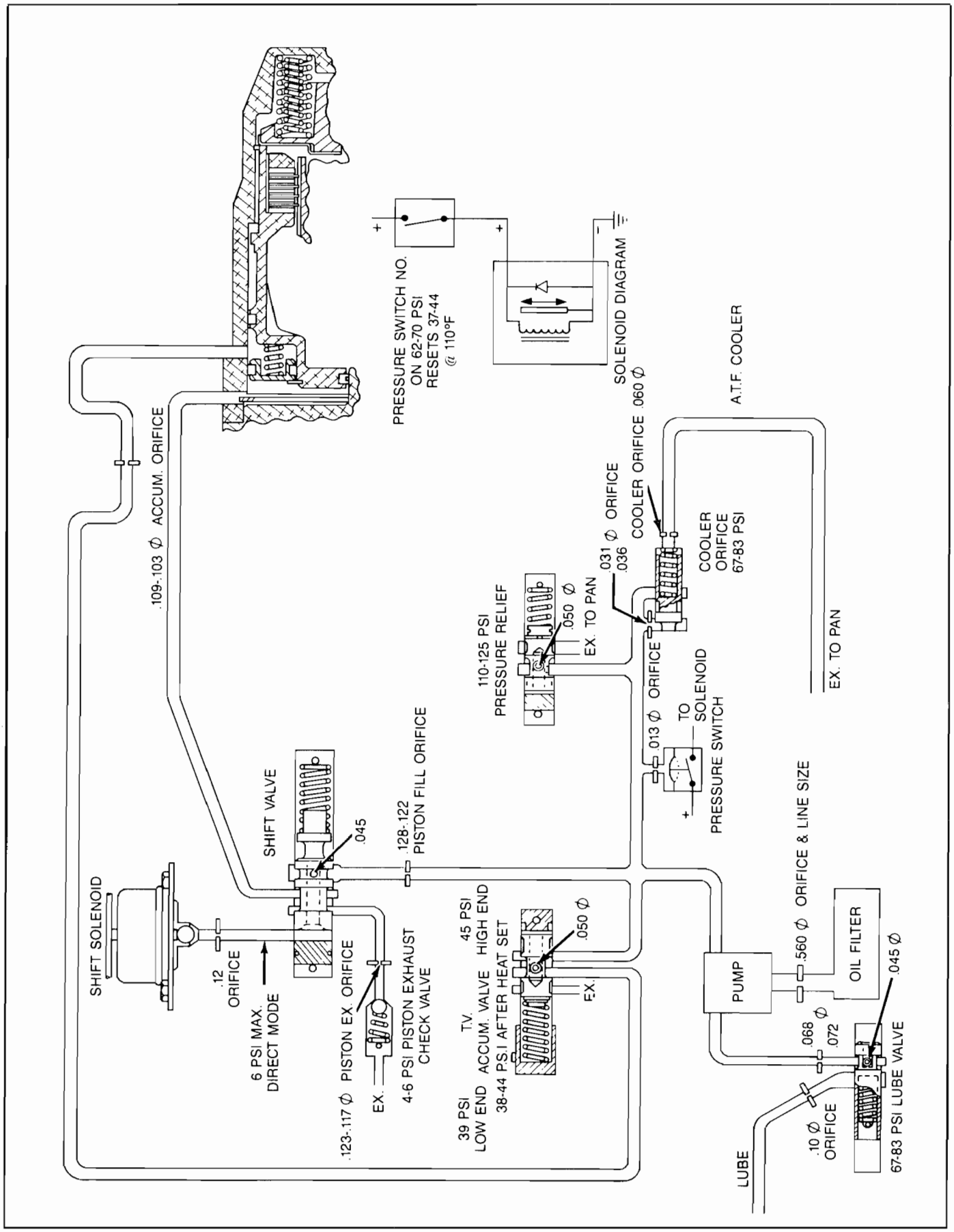


Figure 7B-4b–Hydraulic Circuit

UNIT REPAIR (OVERDRIVE UNIT)

OVERDRIVE UNIT (FIGURE 7B-1B)

Disassembly

Cleanliness is an important factor in the overhaul of the transmission. Before attempting any disassembly operation, the exterior of the transmission should be thoroughly cleaned to prevent the possibility of dirt entering the transmission internal mechanism. During inspection and reassembly, all parts should be thoroughly cleaned with cleaning fluid and then air dried. Wiping cloths or rags should not be used to dry parts. Do not use solvents on neoprene seals, composition-faced clutch plates or thrust washers. All oil passages should be blown out and checked to make sure that they are not obstructed. Small passages should be checked with tag wire. All parts should be inspected to determine which parts are to be replaced.

1. Remove the fill plug and drain oil from the case.
2. Remove the retaining bolt and bracket for the speedometer sensor and driven gear. Remove the sensor and gear.
3. Remove (3) 1/8" pipe plugs from the rear of the unit (Figure 7B-5b).
4. Install the (3) pressure plate retaining bolts (J-34681) until flush with the case. Turn bolts (2) additional turns, by rotating each bolt one turn at at time.

NOTICE: This sequence must be followed in order to prevent the pressure plate from cocking and causing damage to the unit.

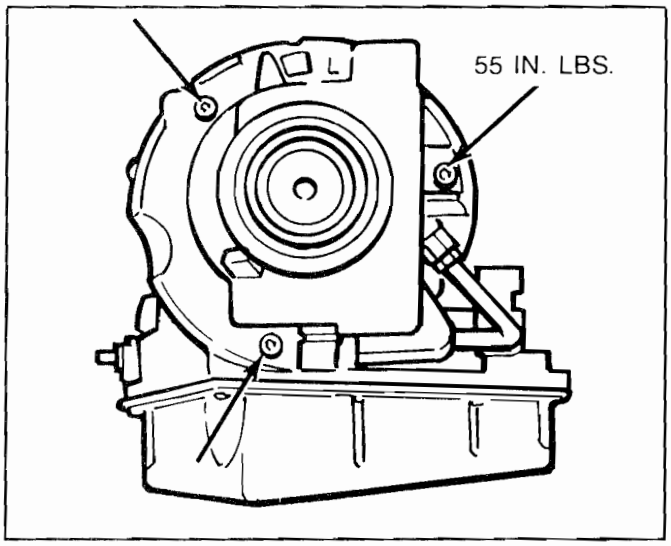


Figure 7B-5b–Plug Locations

5. Remove the (4) Allen head bolts retaining the adapter plate to the case (Figure 7B-6b).
6. Remove the adapter plate, using a hammer (plastic) and screwdriver. Tap adapter plate to separate from case (Figure 7B-7b).

NOTICE: Do not pry between the case and adapter plate, damage to the sealing surfaces could occur.

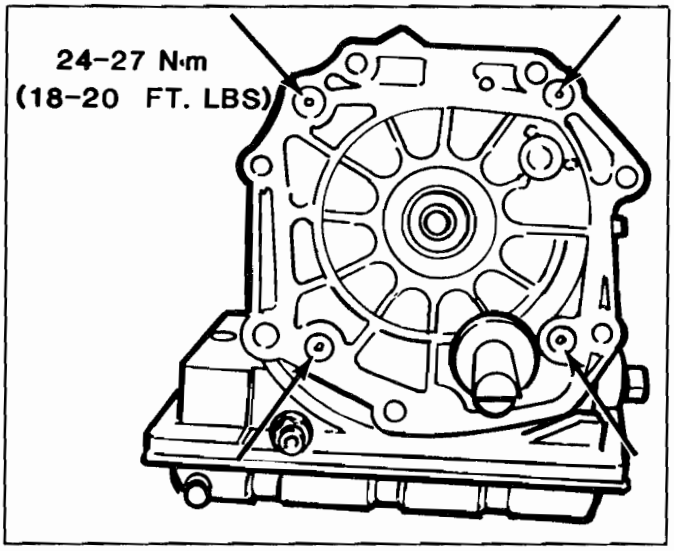


Figure 7B-6b–Adapter Plate

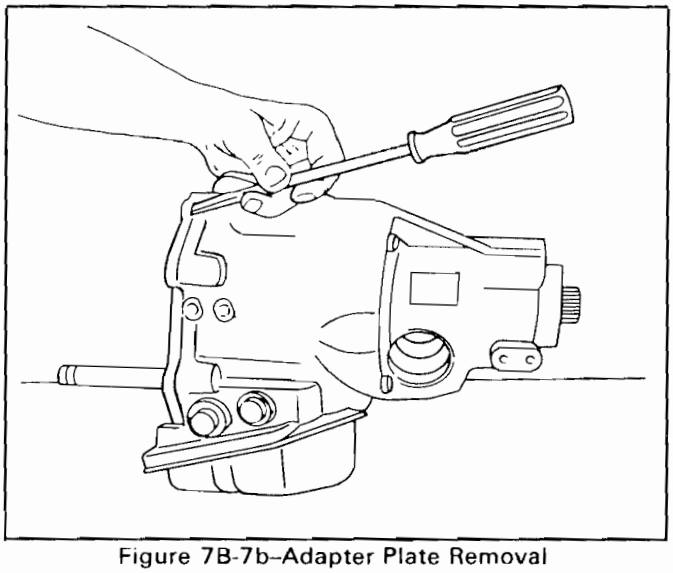


Figure 7B-7b–Adapter Plate Removal

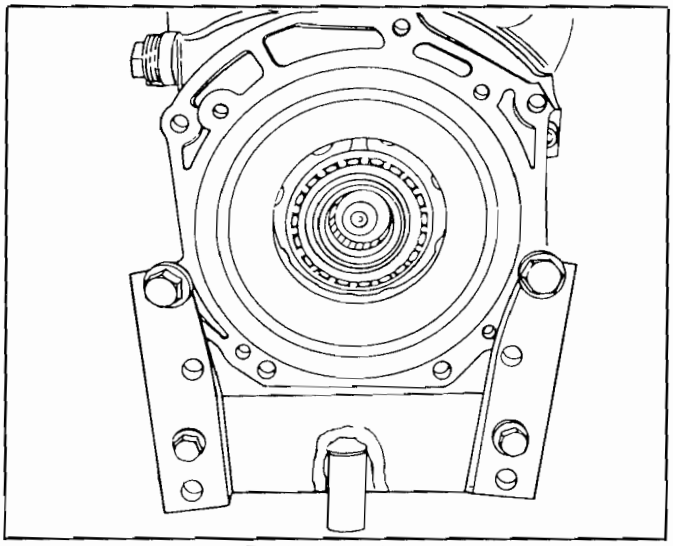


Figure 7B-8b–Holding Fixture

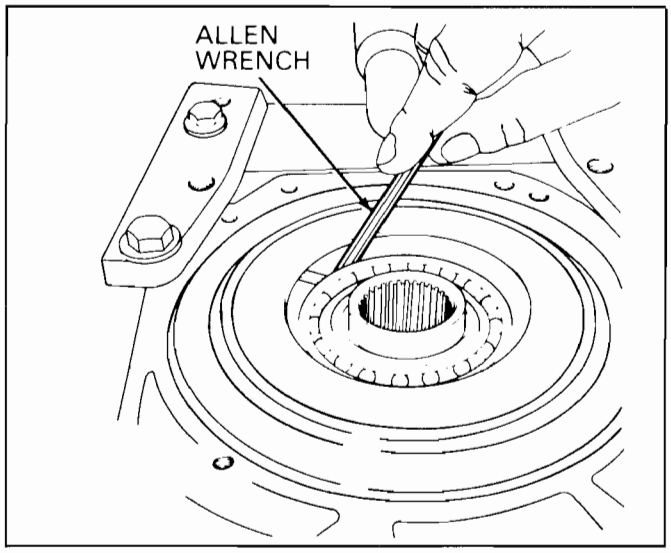


Figure 7B-9b–Piston/Accumulator Removal

7. Bolt the overdrive unit to J-34162. Mount the holding fixture to the base plate J-3389-20 (Figure 7B-8b).
8. Remove the large snap ring from the O/D unit forward of the accumulator piston.

CAUTION: If pressure is felt at snap ring, do not remove. Check to insure the (3) pressure plate retaining bolts (J-34681) are installed. If the bolts are installed, tighten each bolt one additional turn until pressure is relieved. The pressure plate is under a 1350 lb. spring load. If the (3) retaining bolts (J-34681) are not installed, personal injury could occur.

9. Remove the piston/accumulator assembly. Using an Allen wrench, pry the assembly up evenly by lifting under the flange. Do not pry at or near seal surface (Figure 7B-9b).
10. Remove the carrier and bearing assembly (includes input sun and pinion gears) as an assembly.
11. Remove the finger pressure plate (Figure 7B-21b).
12. Remove the overdrive clutches, (5) composition plates, (5) steel plates and (1) clutch stop plate.
13. Remove the direct clutch plates (Figure 7B-20b), (6) composition (6) steel and (1) steel bearing plate.

    Measure each selective clutch plate in the direct clutch pack and record the readings. The selective clutch plates are used to control the clutch pack clearance. When replacing the clutch plates, replace each selective clutch plate with one of the same size.

    Inspect the overdrive and direct clutch plates as follows:

    a. Compositioned Plates.

       Dry plates and inspect for pitting, flaking wear, glazing, cracking, charring and chips or metal particles imbedded in lining. If a compositioned plate shows any of the above conditions, replacement is required.

    b. Steel Plates.

    Wipe plates dry and check for discoloration. If the surface is smooth and even color smear is indicated, the plate should be resued. If severe heat spot discoloration or surface scuffing is indicated, the plate must be replaced.
14. Remove thrust washer and bearing from the output sun gear. Thrust washer may stick to the input sun gear hub.
15. Remove (4) Allen head pump housing retaining bolts by rotating the hub to gain access to the bolts (Figure 7B-11b).

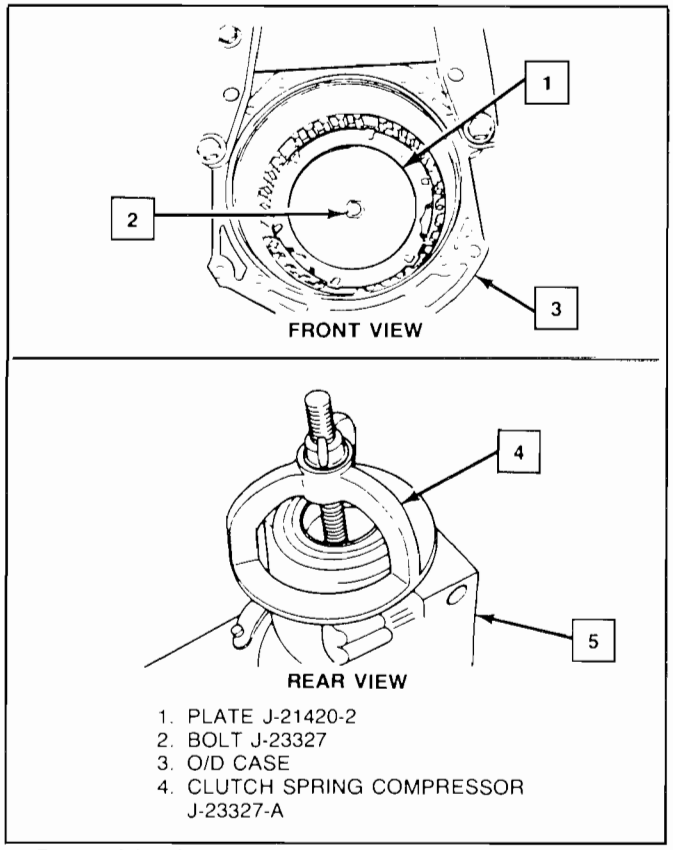


Figure 7B-10b–Pressure Plate Removal/Installation

16. Remove the output shaft assembly (Inc. output sun gear, spag clutch, clutch hub, gerotor pump and speedometer drive gear).
17. Remove the pressure plate and springs by positioning J-21420-2 on the pressure plate with the bolt from J-23327 through the center of the plate. Next position J-23327 on the rear of the case and install the retaining nut (Figure 7B-10b). Remove the (3) retaining bolts, J-34681, from the rear of the case. Loosen the retaining nut on J-23327 bolt to relieve the spring pressure. Remove the pressure plate and springs from the housing.
18. Remove the cooler valve assembly (Figure 7B-12b) by loosening the (2) nuts on the tube and then remove the (2) bolts holding the valve to the case.

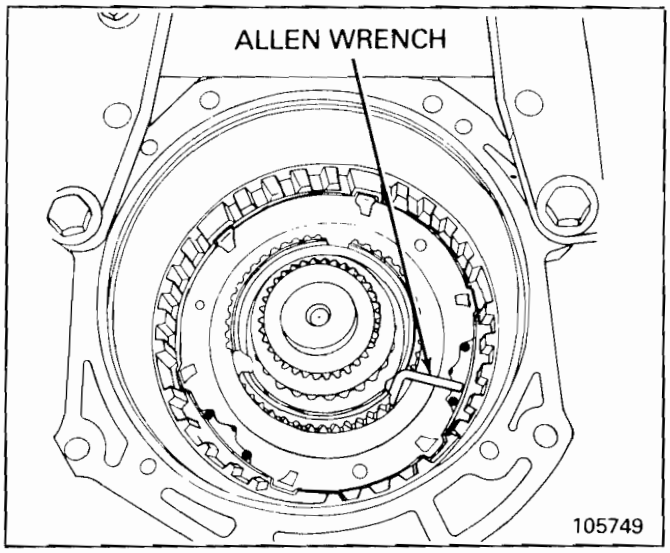


Figure 7B-11b–Pump Retaining Bolts

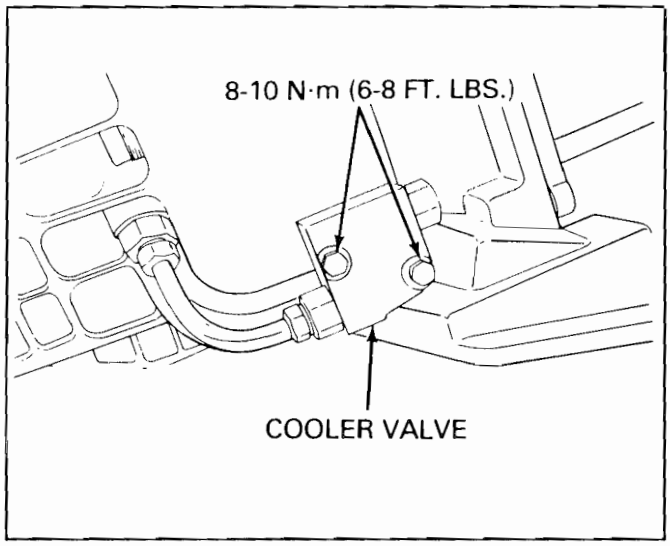


Figure 7B-12b–Cooler Valve

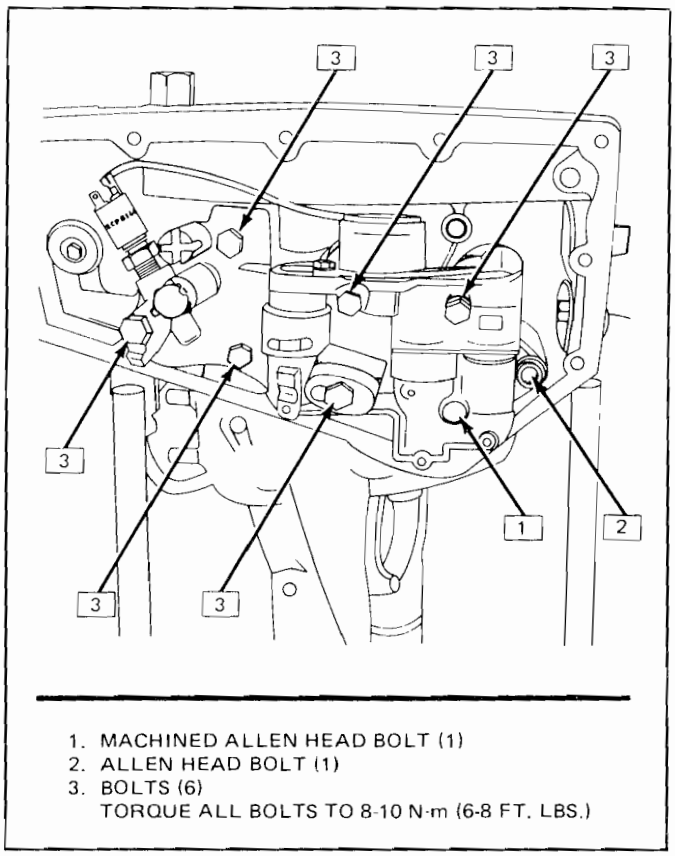
19. Remove the (12) oil pan retaining bolts and then pry the pan from the case.
20. Remove the oil filter from the pick-up tube.
21. Remove the valve body bolts and then remove the valve body with the spacer plate.

NOTICE: There is (1) check ball, which is spring loaded in the valve body.

VALVE BODY (FIGURE 7B-14B)

Disassembly

1. Using Valve Body Spring Compressor Tool J-34529, compress the shift valve spring and remove the retaining pin. Remove the spring and shift valve.
2. Using Valve Body Spring Compressor Tool J-34529,compress the pressure relief valve spring and remove the retaining pin. Remove the spring and pressure relief valve.
3. Using Valve Body Spring Compressor Tool J-34529, compress the accumulator valve spring and remove the retaining pin. Remove the spring, valve, plug, sleeve and plunger.
4. Disconnect the solenoid electrical lead at the pressure switch. Remove the solenoid attaching bolts. Remove the solenoid and check ball.
5. Disconnect the other electrical lead at the pressure switch. Remove the switch from the valve body.



1. MACHINED ALLEN HEAD BOLT (1)
2. ALLEN HEAD BOLT (1)
3. BOLTS (6)
   TORQUE ALL BOLTS TO 8-10 N·m (6-8 FT. LBS.)

Figure 7B-13b–Valve Body Attachments

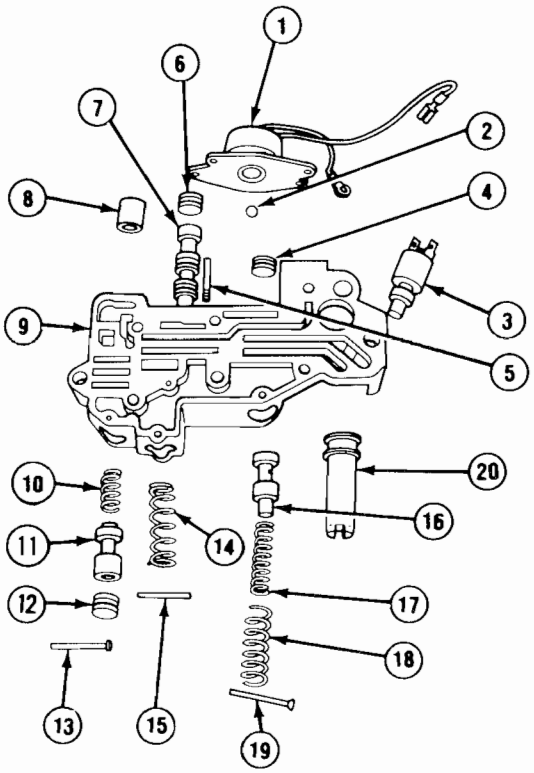
Assembly

1. To assemble, reverse the removal procedures. Coat all the components with clean Dexron II automatic transmission fluid before assembling.

OUTPUT SHAFT (FIGURE 7B-15B)

Disassembly

1. Remove the speedometer gear retaining clip and gear.
2. Remove the (4) Allen head bolts retaining the pump cover to the pump housing. Remove the cover.
3. Remove the oil seal from the pump cover.
4. Mark pump gears with a grease pencil. Gears must be installed in same direction as removed.
5. Position the output shaft with the splines down. Rotate the pump housing until gears slide out.
6. Remove the drive pin from the output shaft.
7. Remove the pump housing from the output shaft.
8. Remove the teflon seal from the pump housing.
9. Remove the thrust washer from the pump housing.



1. SOLENOID
2. SOLENOID CHECK BALL
3. PRESSURE SWITCH
4. END PLUG
5. PIN
6. END PLUG
7. SHIFT VALVE
8. SPRING SEAT
9. VALVE BODY
10. SPRING
11. T.V. VALVE
12. END PLUG
13. PIN
14. SPRING
15. PIN
16. RELIEF VALVE
17. INNER SPRING
18. OUTER SPRING
19. PIN
20. PICKUP TUBE

Figure 7B-14b–Valve Body Components

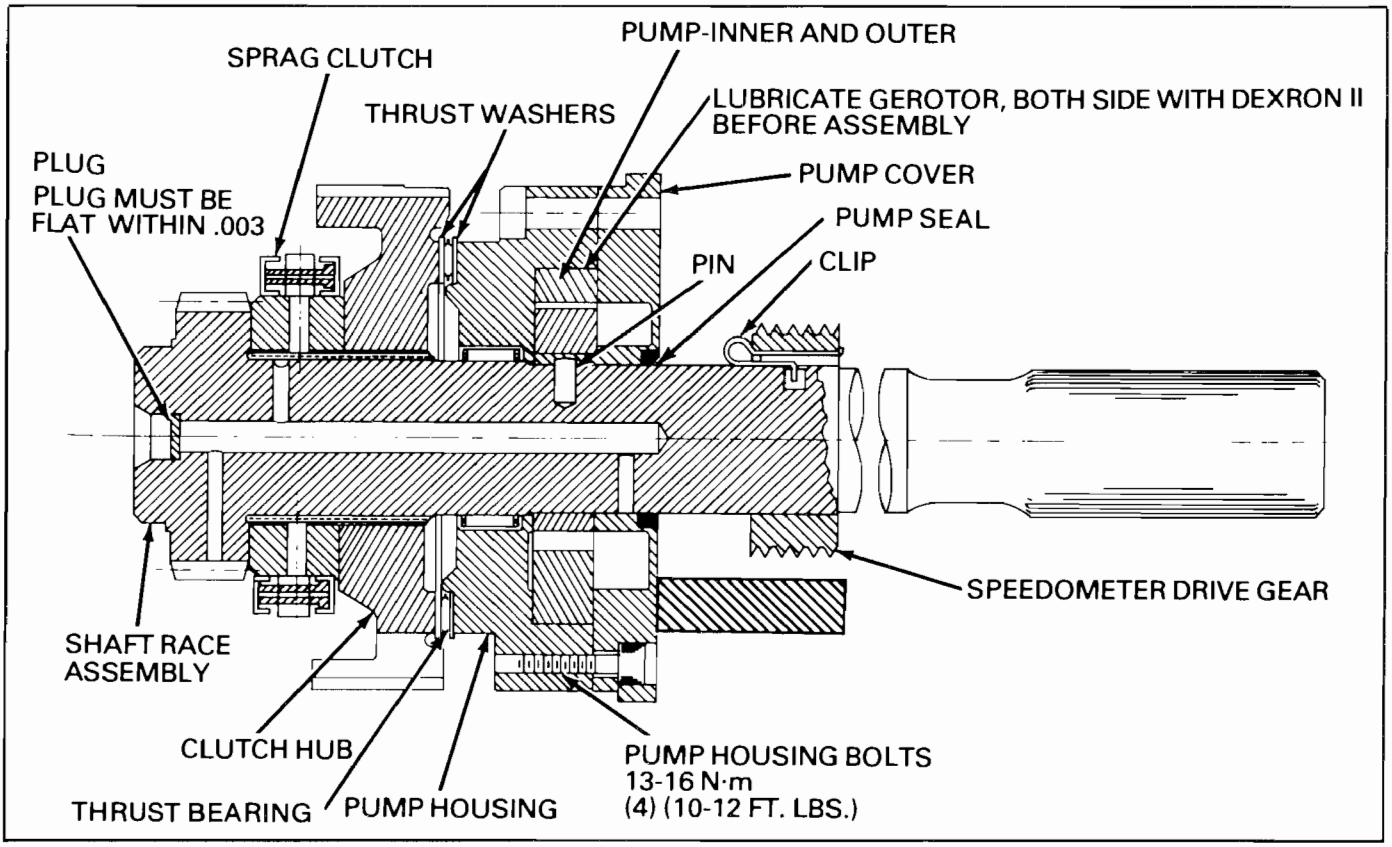


Figure 7B-15b–Output Shaft Assembly

10. Remove the thrust bearing and washer from the clutch hub.
11. Remove the clutch hub from the output shaft. Note the direction of the hub on the shaft. The oil grooves face the sprag clutch or forward on shaft.
12. Remove the sprag clutch from the output shaft. Note direction of the sprag clutch. The lip on the sprag clutch cage goes towards oil grooves on the clutch hub.

Assembly

Coat all parts before assembling with clean Dexron II automatic transmission fluid.

1. Install the sprag clutch on the output shaft. The lip on the sprag clutch cage faces rearward or towards the oil grooves on the clutch hub.
2. Install the clutch hub on the output shaft. The oil grooves on the hub face the sprag clutch or forward on the shaft.
3. Install the thrust washer and then the thrust bearing on the clutch hub.
4. Install the thrust washer on the pump housing. Use petrolatum to retain the thrust washer to the housing.
5. Install the pump housing on the output shaft.
6. Install the pin in the output shaft.
7. Install the pump gears in the housing. Gears must be installed in same direction as removed.
8. Install a new teflon oil seal in pump cover. Coat the I.D. of seal with clean Dexron II automatic transmission fluid.
9. Install pump cover on the pump housing using care not to damage oil seal in pump cover. Align the (4) bolt holes in cover to pump housing. Install the bolts and torque to specifications.
10. Install the speedometer drive gear and retaining clip on the output shaft.
    Check to insure that the speedometer drive gear and retaining clip clear the pump housing when the shaft is turned.
11. Install new "O" rings on pump. Use petrolatum to retain the "O" rings to the housing.

CARRIER ASSEMBLY (FIGURE 7B-16B)

Disassembly

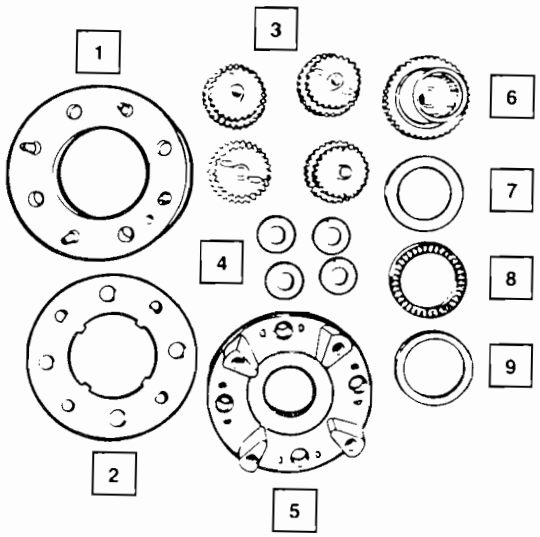
1. Remove the (4) nuts retaining the carrier cover. Remove the cover.
2. Remove the thrust washer, thrust bearing, selective washer and input sun gear.
3. Remove the (4) pinion gears.
4. Remove the steel thrust plate from the carrier.
5. Clean and inspect parts. Replace any parts that are cracked, chipped or show excessive wear.

The carrier assembly must be reassembled in the transmission case.

PISTON/ACCUMULATOR ASSEMBLY (FIGURE 7B-17B)

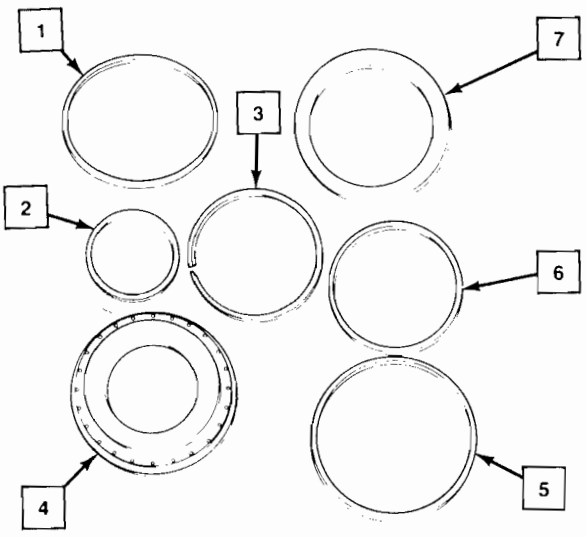
Disassembly

1. Remove the snap ring retaining the accumulator to the piston.



1. CARRIER BASE
2. THRUST PLATE
3. PINION GEARS (4)
4. PINION THRUST WASHERS (4)
5. CARRIER COVER
6. INPUT SUN GEAR
7. SELECTIVE THRUST WASHER
8. THRUST BEARING
9. THRUST WASHER

Figure 7B-16b–Carrier Assembly



1. O/D OUTER QUAD SEAL
2. O/D INNER QUAD SEAL
3. SNAP RING
4. O/D PISTON
5. ACCUMULATOR OUTER QUAD SEAL
6. ACCUMULATOR INNER QUAD SEAL
7. ACCUMULATOR PISTON

Figure 7B-17b–Piston/Accumulator Assembly

2. Remove the accumulator and (48) springs from the piston.
3. Remove the (2) quad seals from the accumulator.
4. Remove the (2) quad seals from the piston.

Assembly

1. To assemble, reverse the removal procedures. Coat the quad seals with clean Dexron II automatic transmission fluid before installing.

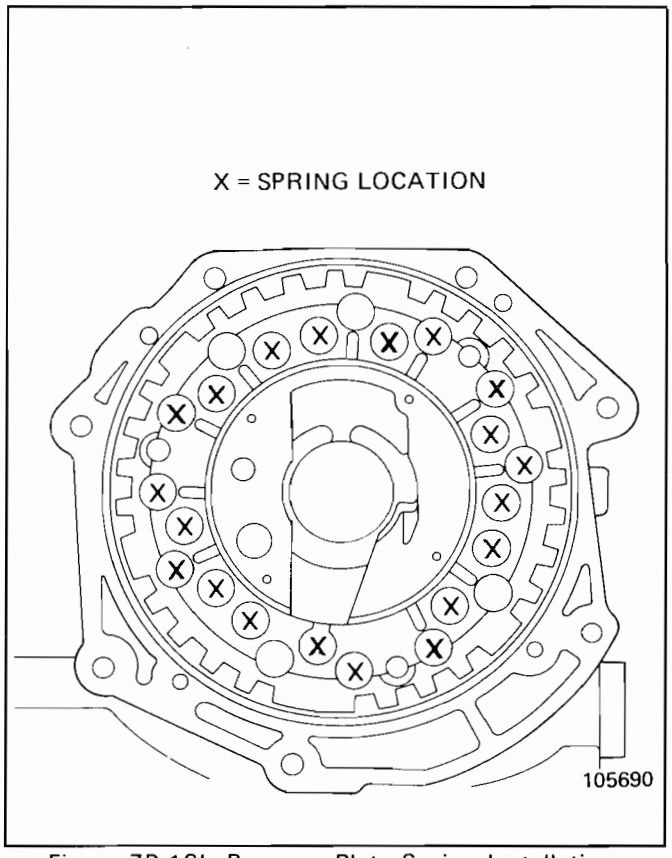


Figure 7B-18b–Pressure Plate Spring Installation

OVERDRIVE UNIT

Assembly

1. Install the pressure plate springs into the pockets of the transmission case.

   The number of springs and location may vary from one transmission to another. Refer to Figure 7B-18b and use as a guide when installing springs.
2. Place the pressure plate on top of the springs. Seat the springs into the pockets of pressure plate.
3. Position plate J-21420-2 on top of the pressure plate with the bolt from J-23327 through the center of the plate. Next position J-23327 on the rear of the case and install the retaining nut. Tighten the nut until the pressure plate is drawn approximately 1/8" below the step for the overdrive clutch plates. Install the (3) pressure plate retaining bolts (J-34681). Remove tools J-21420-2 and J-23327 for the case (Figure 7B-10b).
4. Install the output shaft assembly into the transmission case. Be sure the "O" rings are positioned properly on pump housing before installing the output shaft assembly. Install the (4) pump retaining bolts and torque to specifications.

   Check the alignment of the output shaft to tail housing bushing by installing a slip yoke or the propshaft from the vehicle on the output shaft. Rotate the slip yoke several times, checking for tight rotation. If there is a mis-alignment between slip yoke and tail housing bushing, perform the following steps:
   a. Loosen pump bolts.
   b. Reinstall slip yoke on output shaft.
   c. Torque pump bolts to specification.
   d. Remove slip yoke.

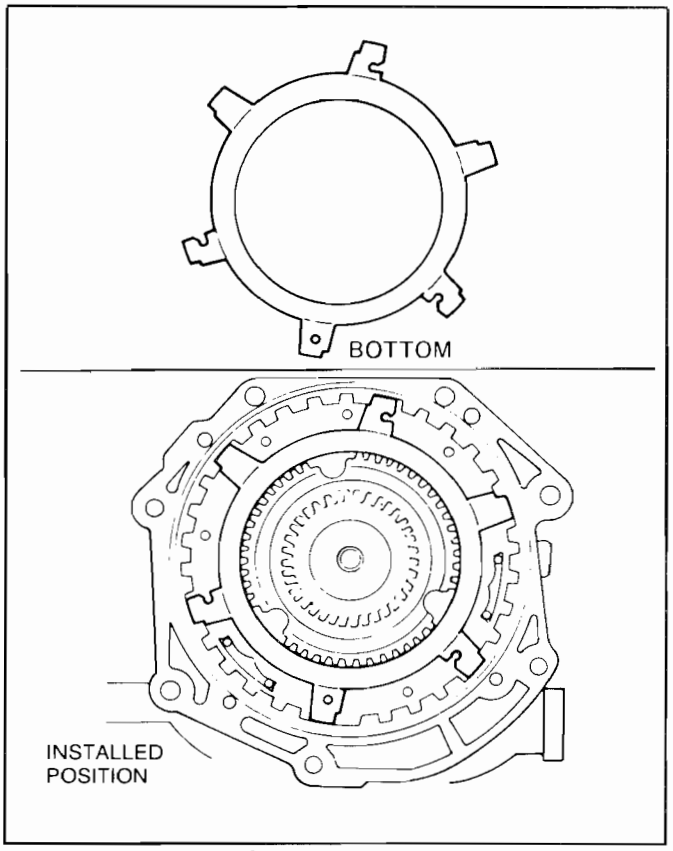


Figure 7B-19b–Tanged Thrust Washer

5. Install the thrust bearing on the output sun gear.
6. Install the tanged direct clutch thrust washer with the tangs facing pressure plate (Figure 7B-19b). The finger on the thrust washer with the drilled hole should be at the bottom of the case or approximately at the 6 o'clock position. Make sure the tabs on the back side of the washer are seated in the pockets in the pressure plate.
7. Install the direct clutch thrust bearing.
8. Install the direct clutch thrust washer. The thrust washer will have a tooth missing from its outer edge. The side of the thrust washer with the circular grind pattern must face the thrust bearing. The side with the grind pattern can be identified by the notch ground into the tooth as shown in Figure 7B-20b.
9. Install one composition clutch disc and then install a selective clutch plate. The selective

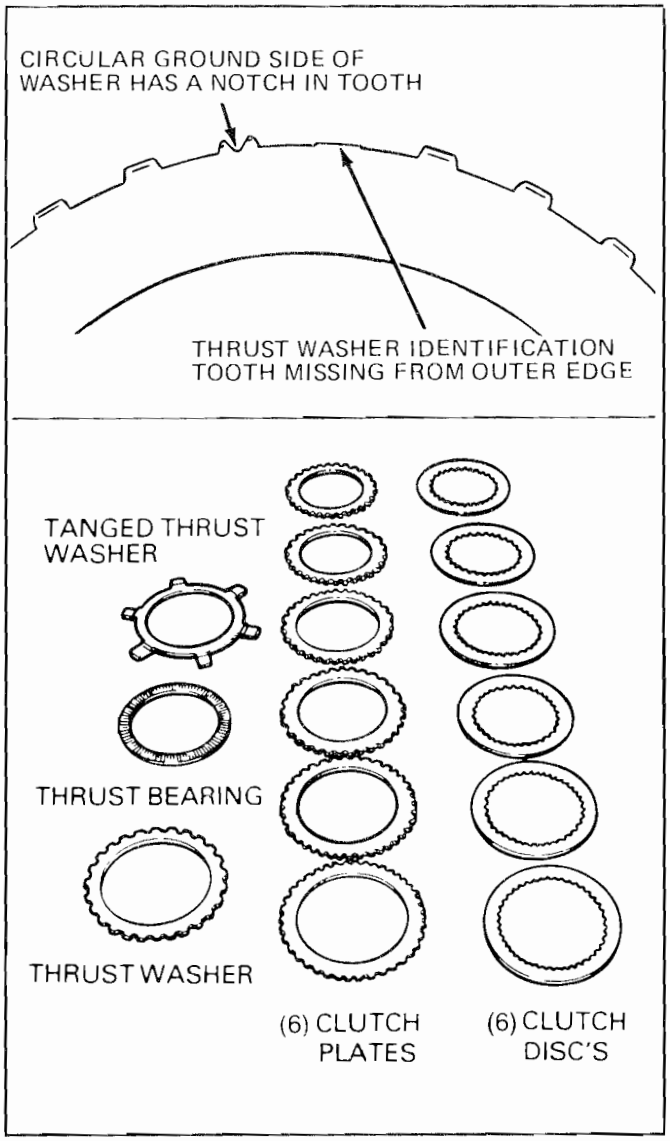


Figure 7B-20b–Direct Clutch Pack

clutch plates come in (5) sizes (.080" to .120") and is used to control clutch pack clearance. A .050" to .070" clearance must be maintained in the direct clutch pack. Excessive or insufficient amount of clutch travel will cause failure to the clutch plates and discs.

10. Alternate the remaining clutch discs and plates until all (6) plates and discs are installed (Figure 7B-20b).
11. Install the lower half of the carrier assembly onto the direct clutch pack. Index the carrier until all clutch plates are engaged.
12. Install the steel overdrive stop clutch plate and then alternate with a disc and plate until all (5) plates and disc are installed (Figure 7B-21b).
13. Install the finger pressure plate.
    Make sure that one of the tabs on the outside edge of the plate is at the 12 o'clock position when installed.
14. Install the carrier thrust plate with tabs facing the sprag clutch.
15. Install (2) pinion gears with the index mark on the gears facing inward or towards each other.

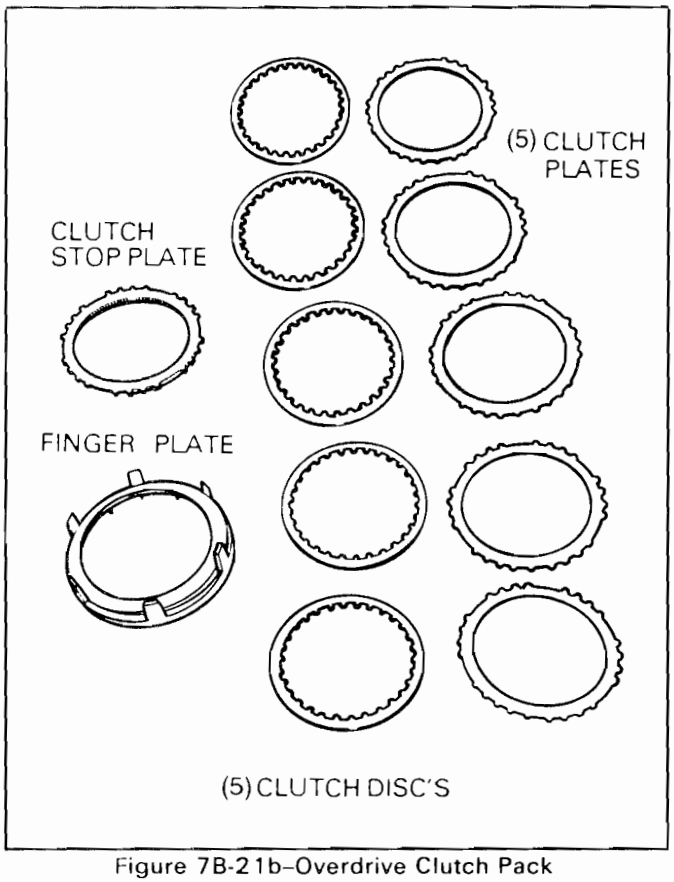


Figure 7B-21b–Overdrive Clutch Pack

Install the other (2) pinion gears with the index mark 90° off from the first (2) gears (Figure 7B-22b).

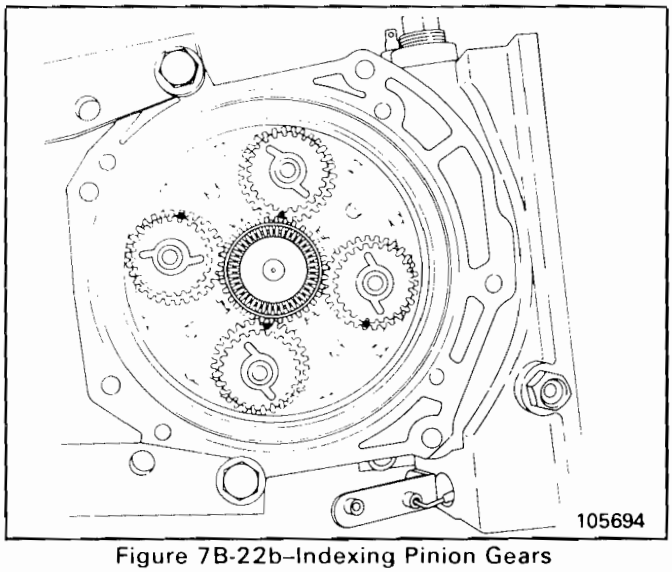


Figure 7B-22b–Indexing Pinion Gears

16. Install the thrust washer for the output sun into the rear of the input sun gear. Use petrolatum to retain the thrust washer to the input sun gear.
17. Install the input sun gear. If the input sun gear spreads the pinion gears when installing, the pinion gears are not indexed properly.
18. Install the selective thrust washer with the oil grooves on washer facing input sun gear.

19. Install the thrust bearing on the input sun gear.
20. Install the carrier thrust washer to the cover. Use petrolatum to retain the thrust washer to the cover.
21. Install the (4) pinion gear thrust washers onto the carrier cover (Figure 7B-23b). Use petrolatum to retain washers to the cover.
22. Install the carrier cover. If the pinion gears are not indexed properly, the cover will not align with the pinion gears.
23. Install (4) new retaining nuts and torque to specification.
24. **Measure the end play for the overdrive unit as follows:**
    a. Place the straight edge J-34673 across the face of the overdrive unit as shown in Figure 7B-24b. Use the Depth Micrometer J-34672 and measure the distance from the inner bearing race to the top of the bar **and add .003" to the Depth Micrometer reading** . Next, measure the thickness of the bar (J-34673) with a 0 to 1 inch micrometer and subtract this from the reading of the depth micrometer (J-34672) and record this reading.

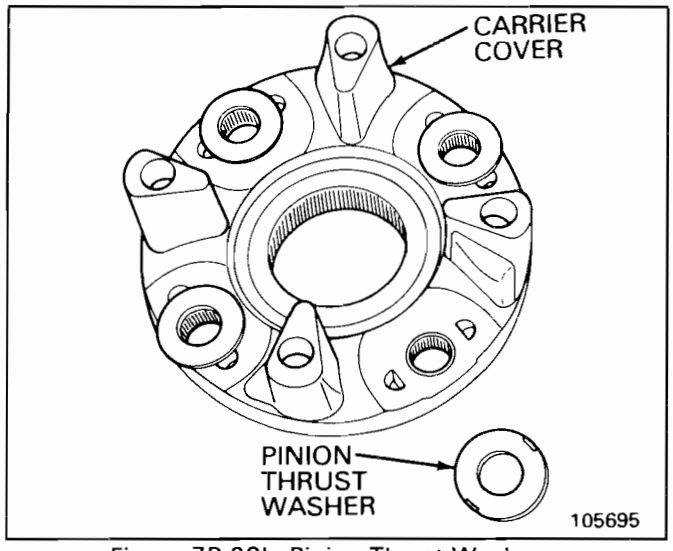


Figure 7B-23b–Pinion Thrust Washers

    b. Place the straight edge J-34673 across the rear of the adapter plate as shown in Figure 7B-25b. Use the Depth Micrometer J-34672 and measure the distance from the top of the bar to the adapter plate mounting surface as shown and record the reading.
    c. Next measure the distance from the top of the bar to the bearing seat in the adapter plate as shown in Figure 7B-26b and record the reading.
    d. Subtract the reading from Step (c) from Step (b) and record the difference.
    e. Next, subtract the difference from step (d) from step (a). The difference will be the end play **(Specification is .000" ± .003").** If the results of your measurements are not within the specifications, it will be necessary to remove the carrier cover and change the input sun selective thrust washer. The

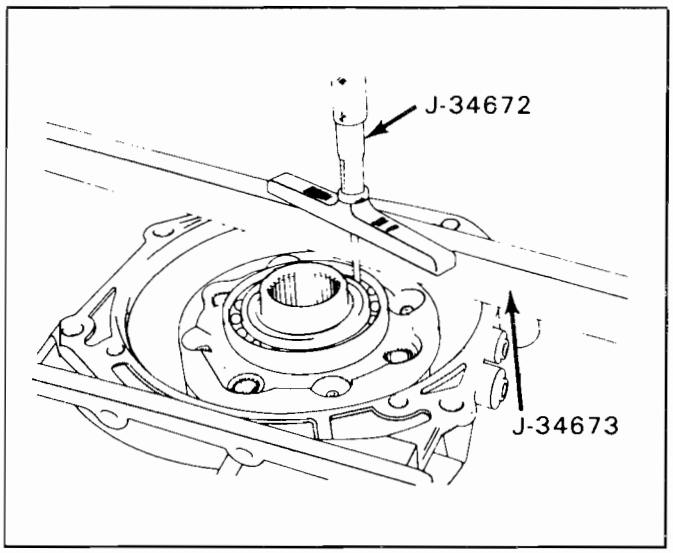


Figure 7B-24b–Measuring End Play (a)

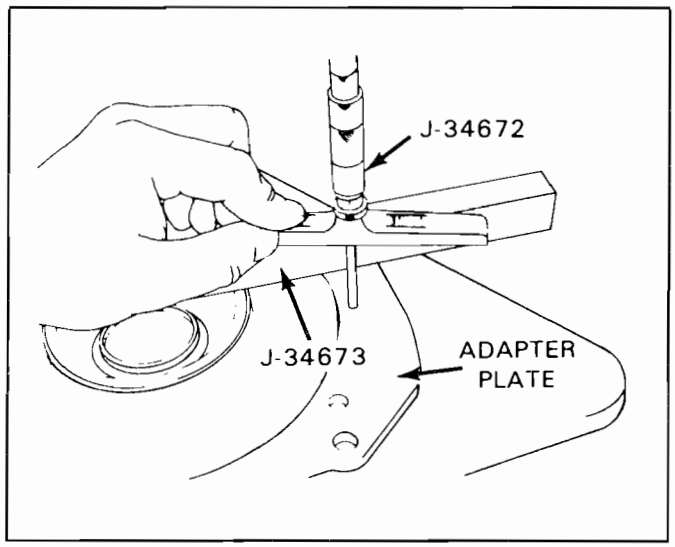


Figure 7B-25b–Measuring End Play (b)

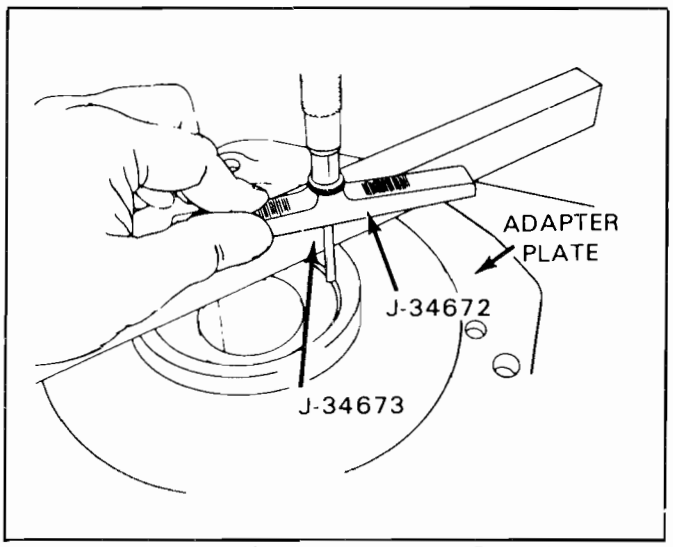


Figure 7B-26b–Measuring End Play (c)

selective thrust washers are available in (8) sizes. They are in .005" increments ranging from .123" to .158".

NOTICE: An incorrect "END PLAY" could fail the carrier bearing or prevent the O/D unit from engaging.

25. Install the accumulator and piston assembly. Coat the lips of the seals with clean Dexron II automatic transmission fluid before installing.
26. Install the large snap ring that goes in the front of the overdrive unit. The snap ring must be installed as shown in Figure 7B-29b.

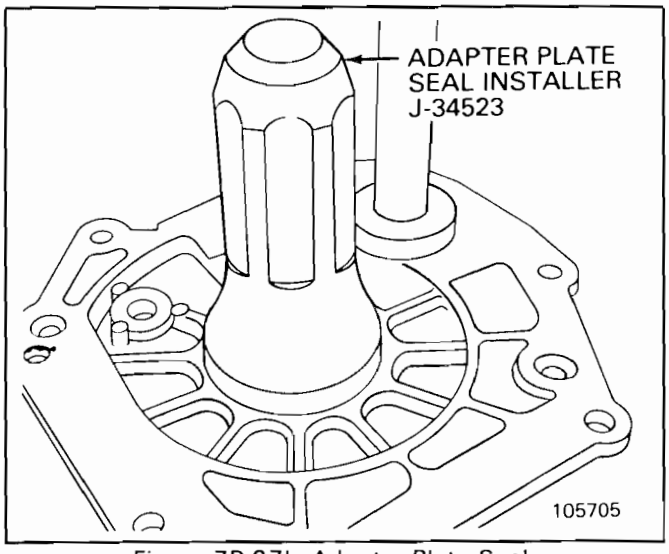


Figure 7B-27b–Adapter Plate Seal

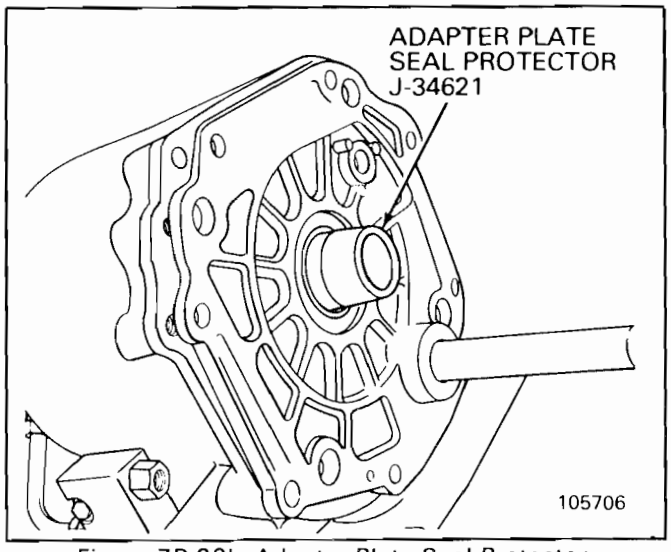


Figure 7B-28b–Adapter Plate Seal Protector

27. Install a new seal in the adapter plate. Place the seal on tool J-34523 and install the seal from the front side of the adapter plate (Figure 7B-27b).
28. Place seal protector J-34621 on the input sun gear.
29. Install the adapter plate. Apply a light coating of R.T.V. Sealant #1052915 or equivalent around the heads of the adapter plate bolts. Install the (4) adapter plate bolts and tighten to specifications.
30. Remove the seal protector.

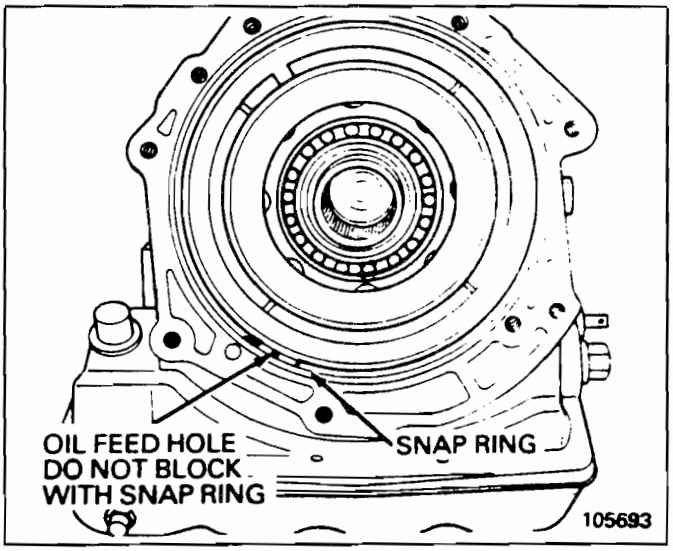


Figure 7B-29b–Snap Ring Installation

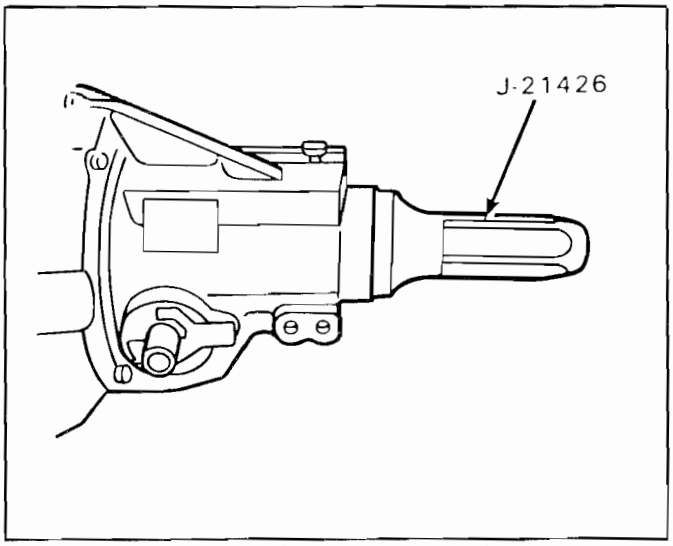


Figure 7B-30b–Using J-21426

31. Install the speedometer driven gear and sensor.
32. Install a new output shaft seal using J-21426 (Figure 7B-30b). Coat the lip of the seal with Dexron II transmission fluid.
33. Install the valve body as follows:
    a. Position (2) gaskets, one on each side of the separator plate.
    b. Install spring and check ball in valve body.
    c. Position the separator plate on the valve body.
    d. Position the valve body to the case and install the retaining bolts. Torque bolts to specifications.
34. Install the oil filter on the pickup tube.
35. Remove the first 1/8 inch pipe plug from the left side of the overdrive unit. Install air line fitting J-34742 into plug hole and tighten (Figure 7B-31b).

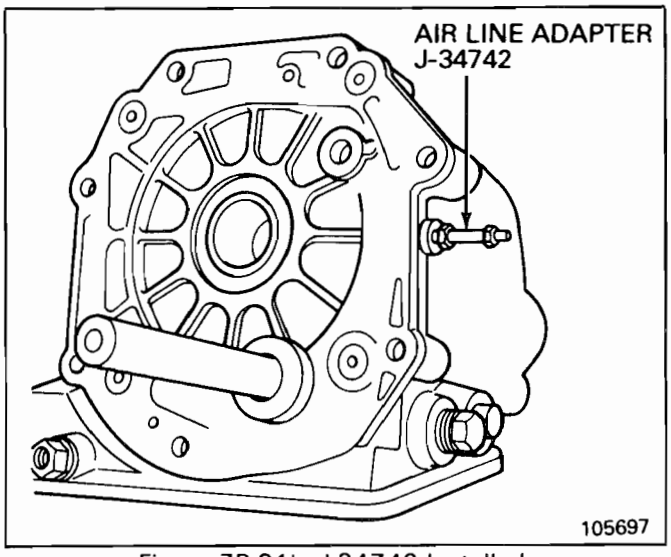


Figure 7B-31b–J-34742 Installed

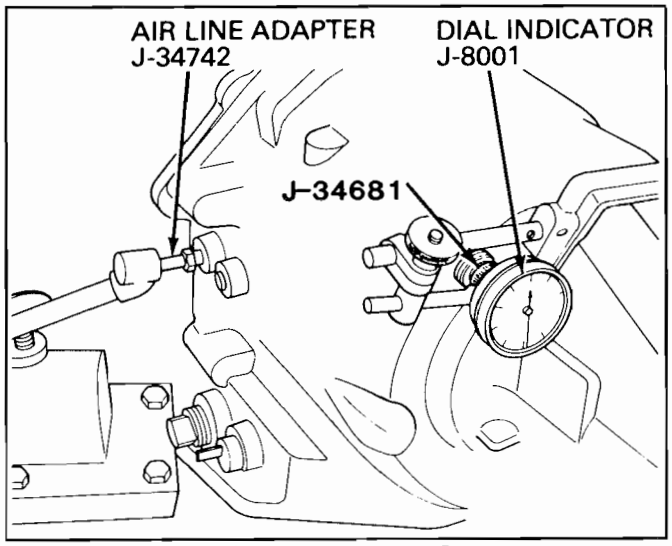


Figure 7B-32b–Clutch Pack Clearance

36. **Measure the clutch pack clearance as follows:**
    a. Loosen the (3) pressure plate retaining bolts (J-34681) evenly until spring pressure is release.
    b. Assemble J-8001 Dial Indicator to the rear of the overdrive unit on the upper left retaining bolt (J-34681). as shown Figure 7B-32b. Preload the indicator and then zero the dial.
    c. Using a small drift, seat the check ball in the valve body (Figure 7B-33b) and apply a minimum of 100 PSI to the air line fitting J-34742 and read the dial indicator (Specification is .050 inch to .070 inch). If the reading does not fall within the specification .050 inch to .070 inch, it will be necessary to disassemble the overdrive unit to change the direct clutch selective clutch plates. The selective clutch plates are available in (5) sizes. They are in .010 inch increments ranging from .080 inch to .120 inch. If the clutch pack clearance is within specifications, remove the (3) clutch pack retaining bolts (J-34681).

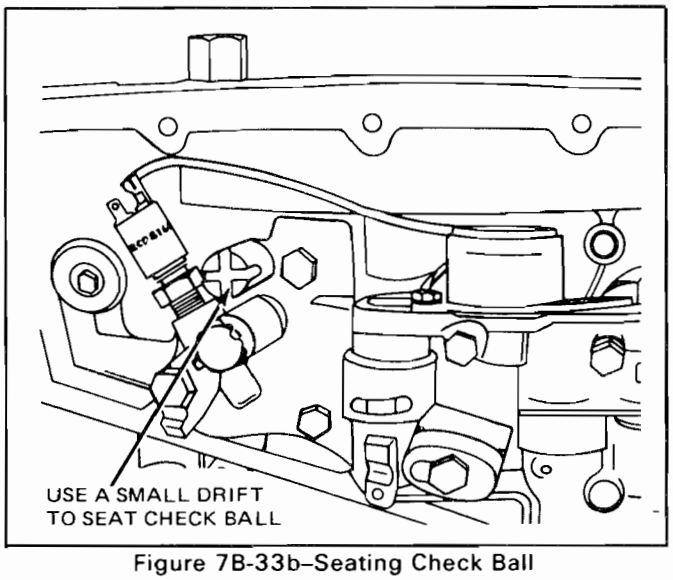


Figure 7B-33b–Seating Check Ball

37. Coat the (3) 1/8" pipe plugs with Loctite Pipe Sealant No. 1052080 or equivalent and install plugs. Torque plugs to specification.
38. Remove the air line adapter J-34742. Coat the plug with Loctite Pipe Sealant No. 1052080 or equivalent and install the plug. Torque plug to specification.
39. Install the magnet in the oil pan as shown in Figure 7B-34b. Apply a bead of R.T.V. Sealant #1052915 or equivalent to the oil pan flange and assemble wet. The bead of R.T.V. should be applied as shown in Figure 7B-34b. Install the pan bolts and torque to specifications.

    NOTICE: The case and oil pan flange surfaces must be free of oil before applying R.T.V. Sealant.
40. Assemble the overdrive unit to the reverse housing. Guide the idler shaft on the adapter plate into the idler gears and align the splines on the mainshaft with the splines in the input sun gear. Slide the units together and install the retaining bolts. Torque bolts to specifications.

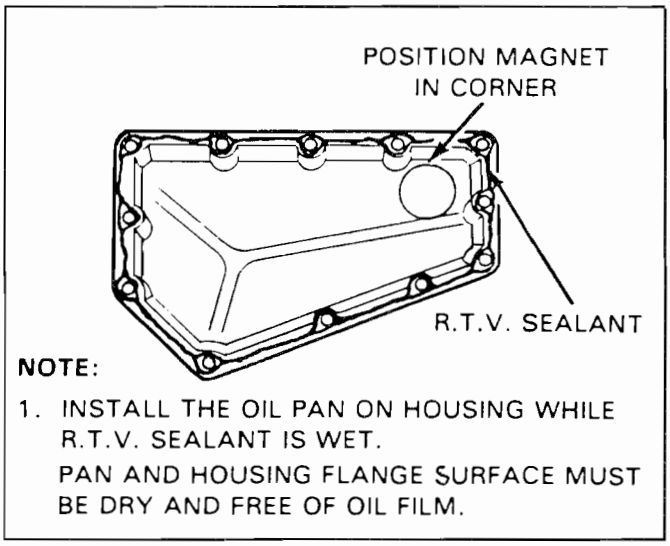
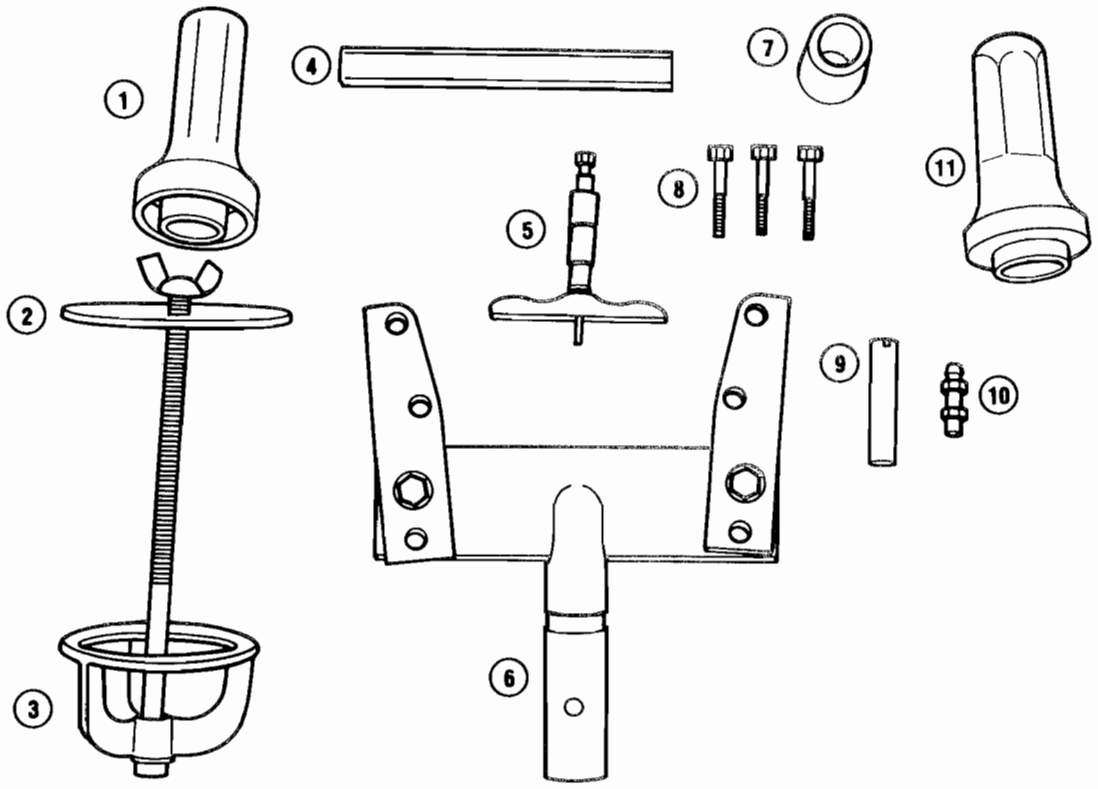


Figure 7B-34b–Magnet and R.T.V. Location

COOLER BLOCK TO CASE BOLTS (2)	8-10 N·m	6-8 FT. LBS.
PRESSURE TAP PLUGS (2)	—	55 IN. LBS.
PRESSURE PLATE ACCESS PLUGS (3)	—	55 IN. LBS.
VALVE BODY TO CASE BOLTS	8-10 N·m	6-8 FT. LBS.
ADAPTER PLATE TO CASE BOLTS	24-27 N·m	18-20 FT. LBS.
OIL PAN TO CASE BOLTS	8-10 N·m	6-8 FT. LBS.
PUMP HOUSING TO CASE BOLTS	8-10 N·m	6-8 FT. LBS.
PUMP COVER TO PUMP CAVITY	13-16 N·m	10-12 FT. LBS.
OVERDRIVE CASE TO REVERSE HOUSING BOLTS	46-48 N·m	34-36 FT. LBS
CARRIER COVER RETAINING NUTS	21-24 N·m	16-18 FT. LBS.

Figure 7B-SP–Specifications



1.	J-21426	OUTPUT SEAL INSTALLER
2.	J-21420-2	CLUTCH SPRING COMPRESSOR PILOT
3.	J-23327	CLUTCH SPRING COMPRESSOR
4.	J-34673	FLAT BAR
5.	J-34672	DEPTH MICROMETER
6.	J-34162	HOLDING FIXTURE
7.	J-34621	SEAL PROTECTOR
8.	J-34681	PRESSURE PLATE BOLTS
9.	J-34529	VALVE BODY SPRING COMPRESSOR
10.	J-34742	AIR LINE ADAPTER
11.	J-34523	ADAPTER PLATE SEAL INSTALLER

Figure 7B-ST–Special Tools

SECTION 7C

CLUTCH

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GENERAL DESCRIPTION

The principal parts of a clutch system are: the driving members, attached to the engine and turning with it; the driven member attached to the transmission and turning with it; the operating members which includes the spring, hydraulic system and the linkage required to apply and release the pressure which holds the driving and driven members in contact with each other. Figure 7C-1 shows a clutch cutaway so operating members can be seen.

DRIVING MEMBERS

The driving members of a clutch consist of two iron plates or flat surfaces machined to a smooth finish. Iron is desirable because it contains enough graphite to provide some lubrication when the driving member is slipping during engagement. One of these surfaces is usually the rear face of the engine flywheel, and the other is a comparatively heavy flat ring with one side machined. This part is known as the pressure plate. It is fitted into a steel cover, which also contains some of the operating members, and is bolted to the flywheel.

DRIVEN MEMBERS

The driven member is the clutch disc with a splined hub which is free to slide lengthwise along the splines of the input shaft; but which drives the shaft throught these same splines. Suitable friction facings are attached to each side of the plate by means of rivets. These facings must be heat resistant since friction produces heat. The most commonly used facings are made of fiberglass thread fibers woven or molded together and impregnated with resin or similar binding agents. Very often, copper wires are woven, or pressed into material to give it additional strength.

In order to make clutch engagement as smooth as possible and eliminate chatter, the steel segments driving the splined hub are slightly waved, which causes the contact pressure on the facings to rise gradually as the waved springs flatten out.

The clutch disc is provided with a flexible center to absorb the torsional vibration of the crankshaft which would be transmitted to the power train unless it were eliminated. The flexible center takes the form of steel compression springs placed between the hub and the steel plate. The springs permit the disc to rotate slightly with relation to its hub until the springs are compressed and relative motion stops. Then the disc can rotate slightly backward as the springs decompress. This slight backward and forward rotation permitted by the springs allows the clutch shaft to rotate at a more uniform rate than the crankshaft, thereby eliminating some of the torsional vibration from the crankshaft and preventing the vibration from being carried back through the transmission.

OPERATING MEMBERS

The driving and driven members are held in contact by spring pressure. This pressure is exerted by a one-piece conical or diaphragm spring. In the diaphragm design clutch, the clutch release bearing moves forward against the spring fingers forcing the diaphragm spring to pivot around the pivot ring, dishing the fingers toward the flywheel. The outer circumference of the spring now lifts away from the pressure plate, allowing the pre-form in the pressure plate drive straps to lift the pressure plate away from the driven disc.

The clutch release bearing is a ball-thrust bearing contained in the clutch housing, mounted on a sleeve attached to the front of the transmission case. The clutch release bearing is moved by the clutch fork to engage the release levers and move the pressure plate to the rear, thus separating the clutch driving members from the driven member when the clutch pedal is depressed by the driver. A piston return spring in the slave cylinder preloads the clutch linkage and assures

contact of the release bearing with the clutch release fingers at all times. As the driven disc wears, the diaphragm spring fingers move rearward forcing the release bearing, fork and push rod to move. This movement forces the slave cylinder piston forward in its bore, displacing hydraulic fluid up into the master cylinder reservoir, thereby providing the "self-adjusting" feature of the hydraulic clutch linkage system.

CLUTCH SPRING OPERATION

In diaphragm spring type clutches, a diaphragm spring is used. It is a conical piece of spring steel punched to give it greater flexibility. The diaphragm is positioned between the cover and the pressure plate so that the diaphragm spring is nearly flat when the clutch is in the engaged position. The action of this type of spring is similar to that of the bottom of an ordinary oil can. The pressure of the outer rim of the spring on the pressure plate decreases as the flat position is passed. The outer rim of the diaphragm bears on the pressure plate and is pivoted on rings approximately 1 in. (25.4 mm) in from the outer edge so that the application of the pressure at the inner section will cause the outer rim to move away from the flywheel and allow the pressure plate to move away from the clutch disc, releasing or disengaging the clutch. When the pressure is released from the inner section, the oil-can action of the diaphragm causes the inner section to move out, and the movement of the outer rim forces the pressure plate against the clutch disc, thus engaging the clutch.

HYDRAULIC CLUTCH SYSTEM

The hydraulic system consists of a master cylinder and a slave cylinder. When pressure is applied to the clutch pedal (pedal depressed), the push rod contacts the plunger and pushes it up the bore of the master cylinder as shown (Figure 7C-4). In the first 1/32 in. of movement, the center valve seal closes the port to the fluid reservoir tank and as the plunger continues to move up the bore of the cylinder, the fluid is forced through the outlet line to the slave cylinder mounted on the clutch housing. As fluid is pushed down the pipe from the master cylinder, this in turn forces the piston in the slave cylinder outward. A push rod is connected to the slave cylinder and rides in the pocket of the clutch fork. As the slave cylinder piston moves rearward the push rod forces the clutch fork and release bearing to disengage the pressure plate from the clutch disc. On the return stroke (pedal released), the plunger moves back as a result of the return pressure of the clutch. Fluid returns to the master cylinder and the final movement of the plunger lifts the valve seal off the seat, allowing an unrestricted flow of fluid between system and reservoir.

DIAGNOSIS

PRELIMINARY CHECKS

Before attempting to repair the clutch, transmission, hydraulic sytem or related linkages for any reason other than an obvious failure, the problem and probable cause should be identified. A large percentage of clutch and manual transmission

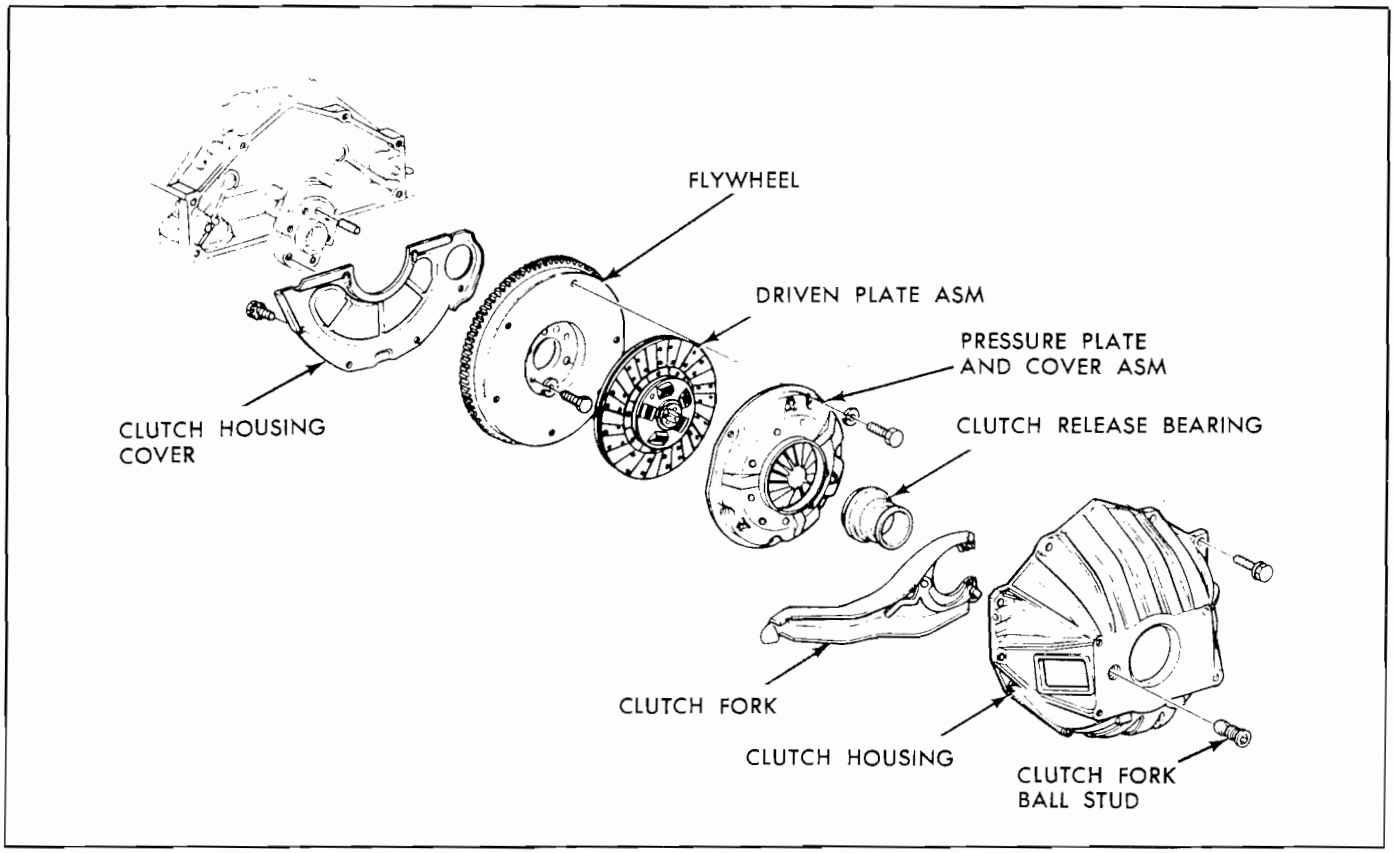


Figure 7C-1–Exploded View of Clutch System

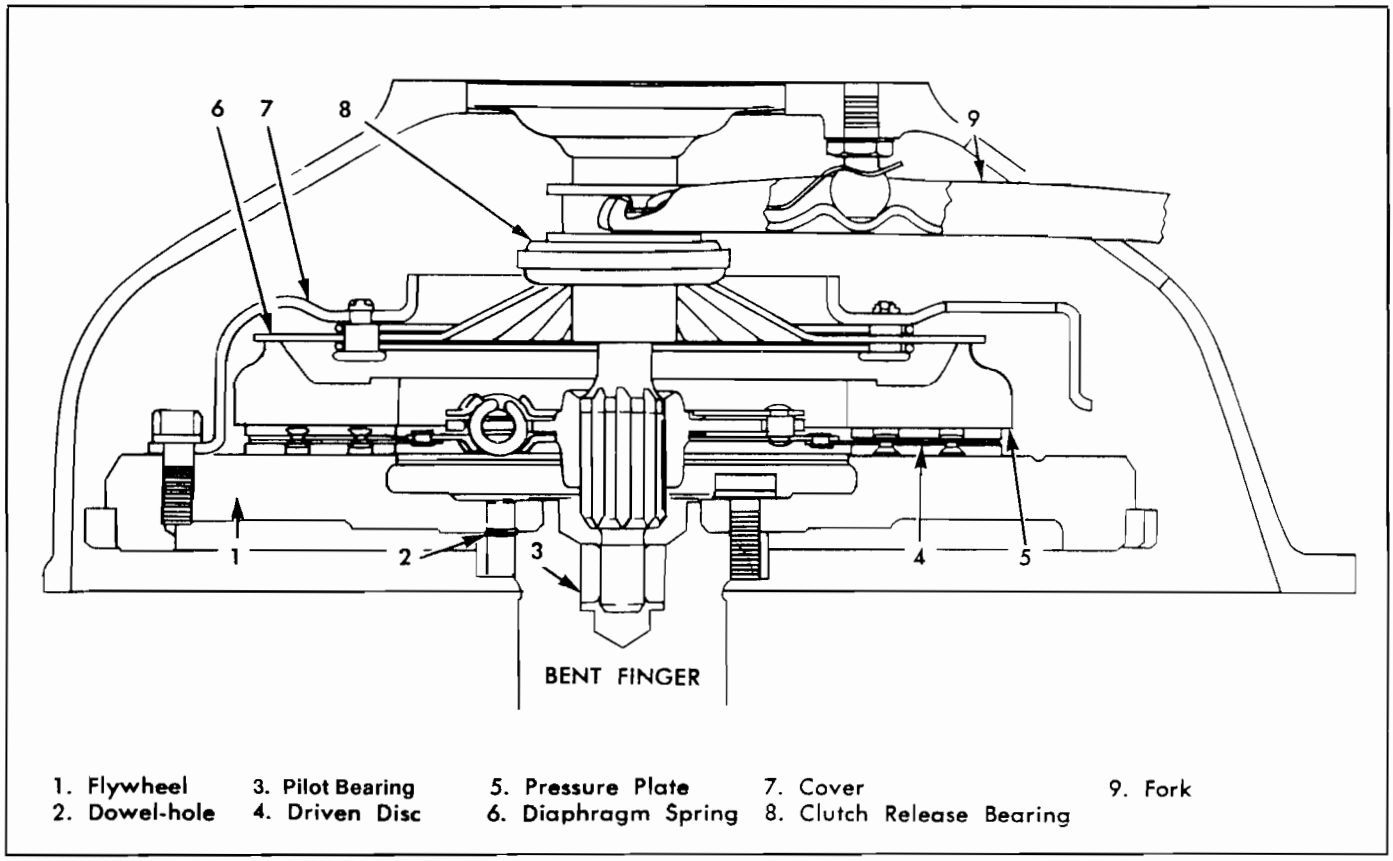


Figure 7C-2–Cross-Section of Clutch Assembly

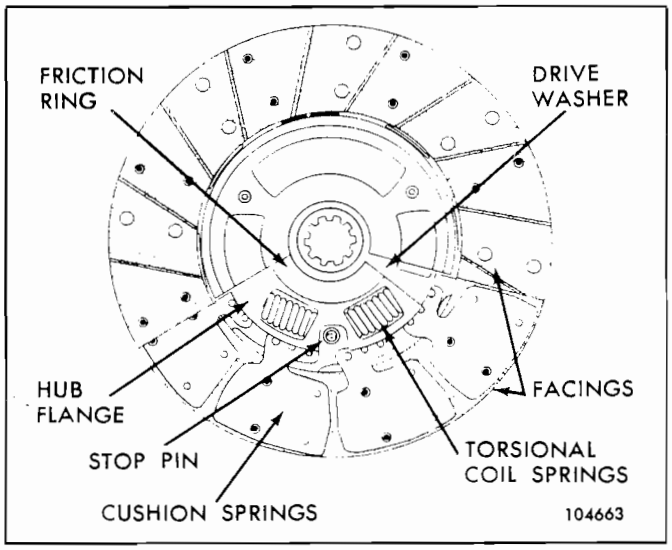


Figure 7C-3–Clutch Disc

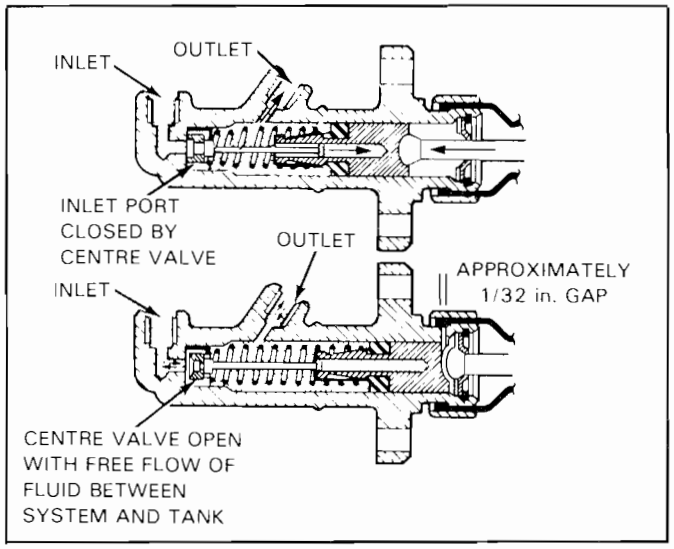


Figure 7C-4–Master Cylinder Cross Section

problems are manifested by shifting difficulties such as high shift effort, gear clash and grinding or transmission blockout. When any of these problems occur, a careful analysis of these difficulties should be accomplished and the following checks and adjustments performed in the presented sequence before removing the clutch or transmission for repairs.

Clutch Adjustment

The hydraulic clutch system provides automatic clutch adjustment. No adjustment of clutch linkage or pedal position is required.

Clutch Spin Down Time

1. Run the engine at a normal idle with transmission in neutral and clutch engaged.
2. Disengage the clutch, wait nine seconds and shift the transmission to reverse. No grinding noise should be heard. A grinding noise indicates incorrect clutch travel, lost motion, clutch misalignment, or internal problems such as failed dampers, facings, cushion springs, diaphragm spring fingers, pressure plate drive straps, pivot rings, etc.

CONDITION	PROBABLE CAUSE	CORRECTION
Fails to release (Pedal pressed to floorshift lever does not move freely in and out of reverse gear)	a. Release bearing improperly installed on fork. b. Improper pedal travel. c. Faulty pilot bearing. d. Faulty driven disc. e. Fork off ball stud. f. Disc hub binding on transmission input shaft spline. g. Disc warped or bent.	a. Install correctly. b. Check for bent clutch pedal or floor mat under pedal. c. Replace bearing. d. Replace disc. e. Install properly and lightly lubricate f. Repair or replace transmission input shaft and/or disc. g. Replace disc (runout should not exceed .020'').
Slipping	a. Oil soaked driven disc. b. Worn facing or facing torn from disc. c. Warped pressure plate or flywheel. d. Weak diaphragm spring. e. Driven plate not seated. f. Driven plate overheated.	a. Install new disc and correct oil leak. b. Replace disc. c. Replace pressure plate or flywheel. d. Replace pressure plate. e. Make 30 to 40 normal starts. Caution: Do not overheat. f. Allow to cool.
Grabbing (Chattering)	a. Oil on facing. Burned or glazed facings. b. Worn splines on disc hub or transmission input shaft. c. Warped pressure plate or flywheel. d. Burned or smeared resin or flywheel or pressure plate. e. Faulty pilot bearing.	a. Install new disc and correct oil leak. b. Replace disc or transmission input shaft. c. Replace pressure plate or flywheel. d. Sand off if superficial, replace burned or heat check parts. e. Replace bearing.
Rattling - Transmission Click	a. Release fork loose on ball stud or in bearing groove. b. Oil in driven plate damper. c. Driven plate damper spring failure. d. Broken return spring in slave cylinder.	a. Check ball stud and retaining spring. b. Replace driven disc and correct oil leak. c. Replace driven disc. d. Replace spring.
Release Bearing Noise with Clutch Fully Engaged	a. Release bearing binding on transmission bearing retainer. b. Fork improperly installed. c. Weak linkage return spring. d. Worn release bearing.	a. Clean, relubricate, check for burrs, nicks, etc. b. Install properly. c. Replace spring. d. Replace release bearing.
Noisy	a. Worn release bearing. b. Fork off ball stud (heavy clicking). c. Pilot bearing loose in crankshaft.	a. Replace bearing. b. Install properly and lubricate fork fingers at bearing. c. Replace bearing.
Pedal Stays on Floor When Disengaged	a. Bind in release bearing. b. Spring weak or broken in pressure plate. c. Spring being over traveled.	a. Lubricate and free up release bearing. b. Replace pressure plate. c. Assure that pedal returns fully to upper stop (push rod stops in master cylinder).
Hard Pedal Effort	a. Bind in linkage. b. Driven plate worn.	a. Lubricate and free up linkage. b. Replace driven plate.

Figure 7C-5–Clutch Diagnosis

MAINTENANCE AND ADJUSTMENTS

INSPECTION

There are several things which affect good clutch operations. Therefore, it is necessary, before performing any major clutch operations to make preliminary inspections to determine whether trouble is actually in the clutch.

Check the clutch to be sure the clutch releases fully as follows:

1. With engine running and brake on, hold the clutch pedal on the floor mat and move shift lever between first and reverse several times. If this can be done smoothly, the clutch is fully releasing. If shift is not smooth, clutch is not fully releasing and inspection is necessary.
2. Check clutch pedal bushings for sticking or excessive wear.
3. Check clutch fork for proper installation on ball stud. Lack of lubrication on fork can cause fork to be pulled off the ball.
4. Check slave cylinder and clutch pedal travel. The slave and clutch pedal cylinder should have .70" travel (measure travel at the clutch fork) with the clutch pedal fully depressed. The clutch pedal should have approximately 7-3/8" travel fully depressed.

BLEEDING CLUTCH SYSTEM

The process of removing air from the pipe line and cylinders is known as "bleeding" and is necessary whenever any part of the system has been disconnected, or level of fluid in the reservoir has been allowed to fall so low that air has been drawn into the master cylinder.

1. Fill master cylinder reservoir with new brake fluid conforming to Dot 3.

   NOTICE: Never, under any circumstances, use fluid which has been bled from a system to fill the reservoir as it may be aerated, have too much moisture content and possibly be contaminated.

2. Raise vehicle.
3. Remove the slave cylinder attaching bolts.
4. Hold slave cylinder at approximately 45° with the bleeder at highest point. Fully depress clutch pedal and open bleeder.
5. Close bleeder valve and release clutch pedal.
6. Repeat Steps 4 and 5 until all air is evacuated. Check and refill master cylinder reservoir as required to prevent air from being drawn through master cylinder.

ON VEHICLE SERVICE

CLUTCH ASSEMBLY

Removal

1. Disconnect negative battery cable.
2. Remove distributor cap and lay aside.

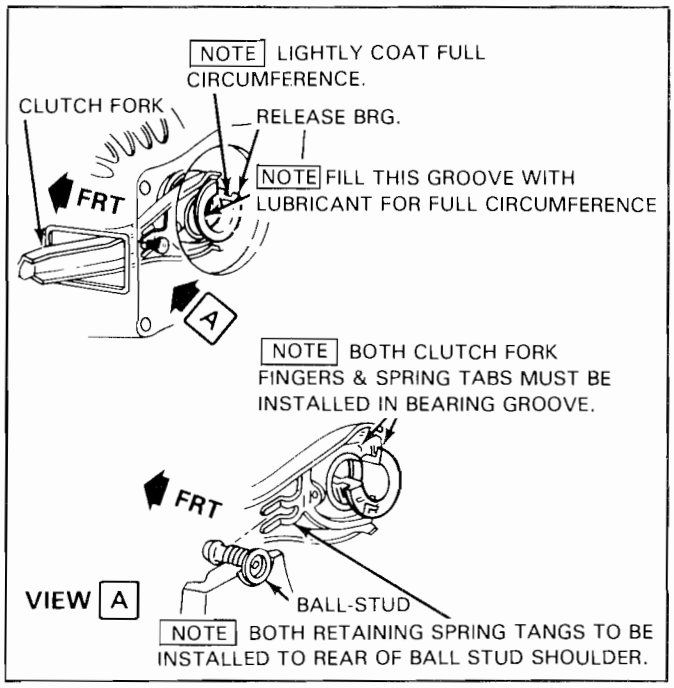


Figure 7C-6–Release Bearing Lubrication Areas

3. Raise vehicle and support on stands.
4. Remove the upper and lower underbody braces on vehicles equipped with a convertible top.
5. Remove the complete exhaust system as an assembly by:
   a. Disconnect A.I.R. pipe at the converter.
   b. Disconnect A.I.R. pipe clamps at exhaust manifold.
   c. Disconnect oxygen sensor electrical lead.
   d. Remove the exhaust hanger bolts at the driveline support beam.
   e. Remove the bolts attaching the mufflers to the hangers.
   f. Remove hanger bracket at the converter.
   g. Disconnect the exhaust pipes from the exhaust manifolds remove the exhaust system.
6. Remove the exhaust hanger at the transmission.
7. Support the transmission with a jack.
8. Remove the bolts attaching the driveline support beam at the axle and transmission. Remove the driveline support beam from the vehicle.
9. Mark the relationship of the propeller shaft to the axle companion flange. Remove the trunnion bearing straps and disengage the rear universal joint from the axle. Slide the propeller shaft slip yoke out from the overdrive unit and remove shaft from the vehicle.
10. Disconnect the cooler lines at the overdrive unit.
11. Disconnect the shift linkage at the side cover.
12. Disconnect the electrical connectors at the transmission--backup light switch (1), overdrive unit (1) 1st gear switch (1) and speedometer sensor (1).
13. Lower the transmission and support the engine.
14. Remove the (4) bolts attaching the transmission to the clutch housing. Slide the transmission

rearward to disengage the input shaft from the clutch. Remove the transmission from the vehicle.

15. Remove slave cylinder attaching bolts.
16. Remove clutch housing bolts and housing from engine.
17. Slide clutch fork from ball stud and remove fork from dust boot. Ball stud is threaded into clutch housing and is easily replaced, if necessary.
18. Install Tool J-5824 to support the clutch assembly during removal. Look for "X" mark or white painted letter on clutch cover and "X" mark on flywheel. If "X" mark or letter is not evident, mark flywheel and clutch cover for indexing purposes during installation.
19. Loosen the clutch-to-flywheel attaching bolts evenly 1 turn at a time until spring pressure is released, then remove the bolts, and remove clutch and pressure plate assembly.
20. Inspect the flywheel for cracks, heat checking or other defects. Replace or repair as required.

Installation

Clean pressure plate and flywheel face. (They should be free of oil, grease, metal deposits or burned spots).

1. Position the clutch disc and pressure plate in relative installed position and support them with alignment Tool J-5824 or a drive gear. The driven disc is installed with the damper springs to the transmission. The flywheel side is marked.
2. Turn clutch assembly until "X" mark or white painted letter on cover lines up with "X" mark on flywheel, then align cover bolt holes to nearest flywheel holes.
3. Install a bolt in every hole and tighten down evenly and gradually until tight to avoid possible clutch distortion. (Cover loads are as high as 1-1/4 tons.)
4. Remove pilot tool.
5. Unhook clutch fork and lubricate ball socket and fork fingers at release bearing end with a high melting point grease such as graphite and reinstall fork on ball stud.
6. Lubricate the recess on the inside of release bearing collar and the clutch fork groove with a light coat of graphite grease (Figure 7C-6).
7. Install clutch fork into clutch housing and install release bearing to the fork, then install clutch housing and attaching bolts. Torque clutch housing bolts to 27 to 47 N·m (25 to 35 ft. lbs.).
8. Install transmission and attaching bolts. Torque transmission bolts to 60 to 80 N·m (45 to 60 ft. lbs.).
9. Lubricate full length of the slave cylinder push rod and then install push rod into boot.
10. Install dust boot onto slave cylinder insuring that end of push rod is in piston recess.
11. Install slave cylinder and attaching bolts insuring that push rod engages pocket in end of clutch fork.
12. Install dust boot to clutch housing.
13. Connect oil cooler line pipes to the overdrive unit. Torque fittings to 11-16 N·m (8-12 ft. lbs.).
14. Install and align the driveline support beam as follows:
    - To insure proper alignment of the driveline, a clearance of 45mm±6 (1.77″±250″) must be maintained between the top of the beam to the underbody and a clearance of 28mm±6 (1.1″±.250″) from the right side (passenger side of vehicle) of the beam to the side wall.
    - Take these measurements directly above and to the right of the front propeller shaft yoke.
    - Refer to the Rear Suspension Section (3D) for sealing and torque specifications.

    NOTICE: Do not over torque the bolts attaching the driveline beam to the transmission. Over-torquing can damage the bushing and seal in the overdrive unit and result in fluid leakage. Inadequate fluid level will damage the transmission.
15. Install propeller shaft. Refer to Propeller Shaft Section (4A) for installation and torque specifications.
16. Connect and adjust shift linkage as outlined in Transmission Section (7B).
17. Connect the electrical connectors for the backup light switch, overdrive unit, 1st gear switch and speedometer sensor.
18. Install exhaust system. Refer to Exhaust System Section (6F) for installation and torque specifications.
19. Install the upper and lower underbody braces on vehicles equipped with a convertible top. Refer to the Body Section for installation and torque specifications.

CLUTCH PEDAL (FIGURE 7C-7)

Replacement

1. Disconnect negative cable at battery.
2. Remove hush pad from under dash.
3. If equipped, remove cruise control switch at clutch pedal.
4. Disconnect and remove neutral start switch at clutch pedal.
5. Disconnect clutch pedal rod from pedal.
6. Remove nut from clutch pedal pivot bolt. Pull bolt out for pedal removal.
7. Clean and inspect all components and replace as necessary. Do not clean bushings with a cleaning solvent, simply wipe with a clean cloth. Relubricate all bushings and moving parts.
8. To install, reverse removal procedure.

NEUTRAL START SWITCH (FIGURE 7C-8)

Replacement

1. Disconnect negative cable at battery.
2. Remove hush pad from under dash.

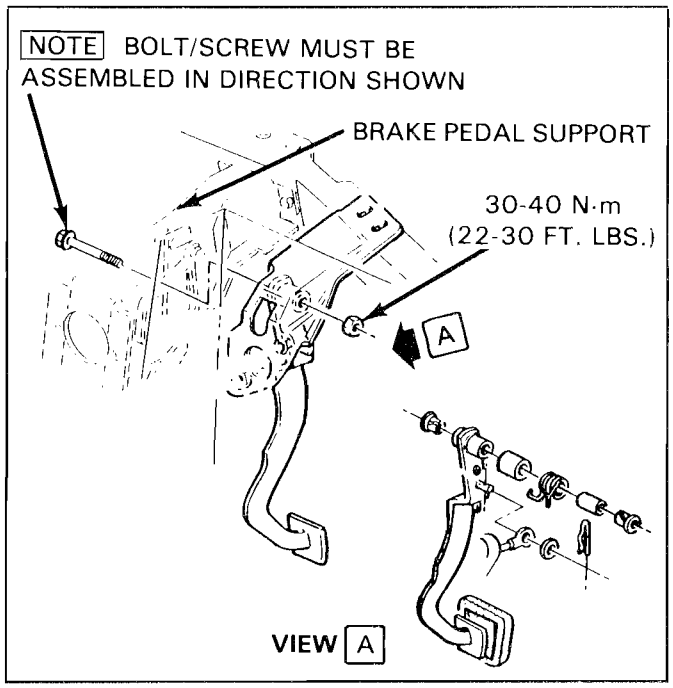


Figure 7C-7–Clutch Pedal Attachment

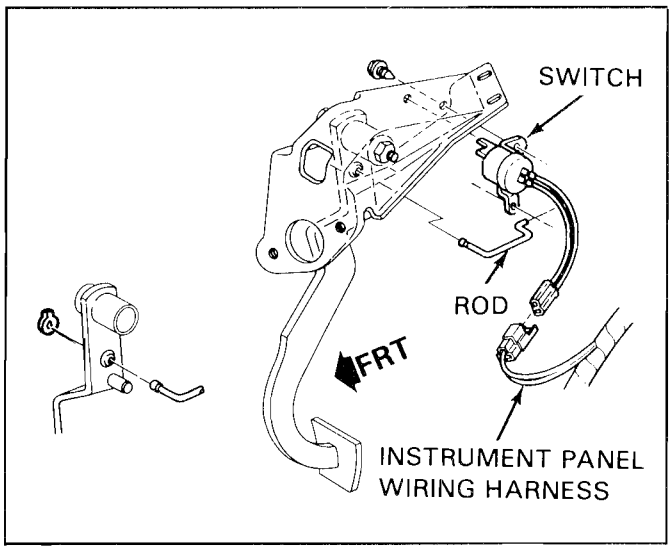


Figure 7C-8–Neutral Start Switch

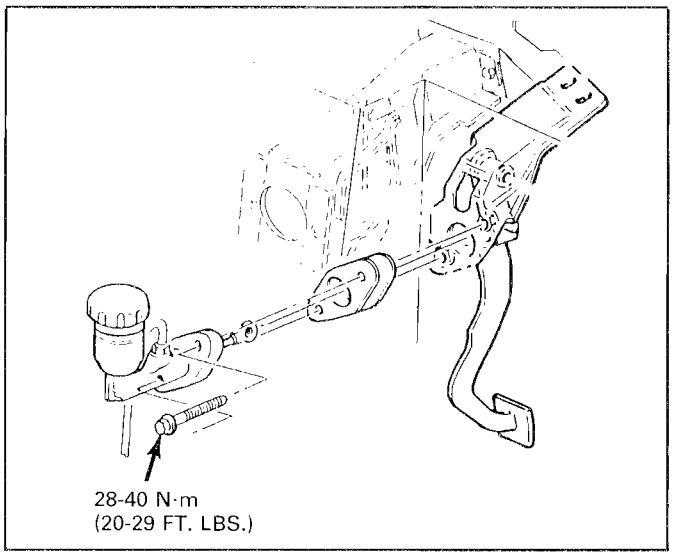


Figure 7C-9 – Master Cylinder (Clutch)

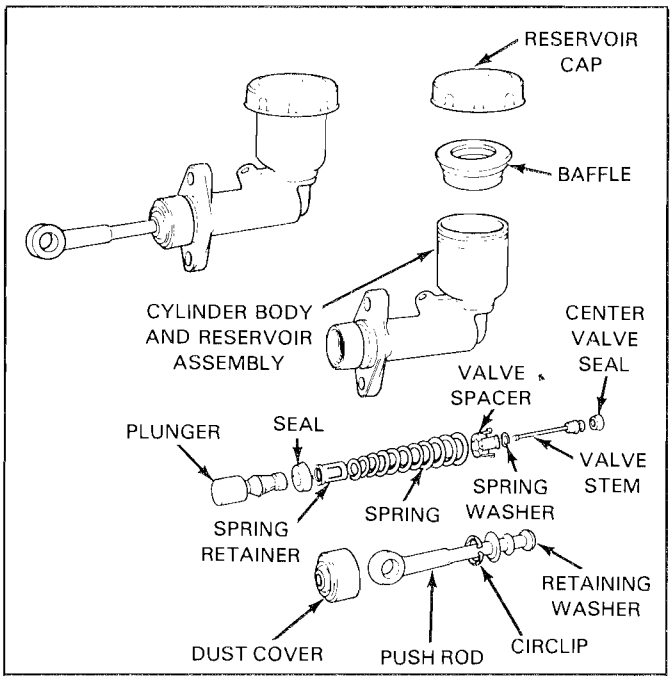


Figure 7C-10–Master Cylinder Exploded View

3. Remove clip from rod at clutch pedal.
4. Remove mounting bolt from clutch pedal support bracket.
5. Disconnect electrical lead at the switch.
6. To install, reverse the removal procedure.

MASTER CYLINDER (CLUTCH)

Removal

1. Disconnect negative cable at battery.
2. Remove hush panel from under dash.
3. Disconnect push rod from clutch pedal.
4. Disconnect hydraulic line at the master cylinder.
5. Remove the mounting bolts for the master cylinder at front of dash.

Disassembly

1. Remove filler cap and drain fluid from master cylinder.
2. Pull back the dust cover and remove the circlip.
3. Remove retaining washer and push rod. Tap the master cylinder on a block of wood to eject the plunger assembly from the cylinder bore.
4. Lift the tab on the spring retainer and remove the spring assembly from the plunger.
5. Compress the spring to free the valve stem from the keyhole of the spring retainer.
6. Remove the spring, valve spacer and spring washer from the valve stem and the valve seal from the valve head.
7. Remove the seal carefully from the plunger, ensuring no damage occurs to the plunger surfaces.

Replace all seals and clean the remaining parts in clean brake fluid. Inspect the cylinder bore for visible scores and ridges and check that its smooth to the touch. Replace the master cylinder if any of the above conditions exist.

Assembly

1. Fit the plunger seal to the plunger.
2. Fit the valve seal, smallest diameter leading to the valve head.
3. Position the spring washer on the valve stem so that it "flares" away from the valve stem shoulder (as illustrated) and follow with valve spacer, legs first, and spring.
4. Fit the spring retainer to the spring and compress the spring until the valve stem passes through the key hole slot and engages in the center.
5. Fit the spring to the plunger and press the tab of the spring retainer to secure.
6. Lubricate the seals and the cylinder bore with new brake fluid conforming to Dot 3.
7. Insert the plunger assembly, valve end leading into the cylinder bore, easing the entrace of the plunger seal.
8. Position the push rod and retaining washer into the cylinder bore. Install a new circlip to retain the push rod. Install dust cover onto the master cylinder. Smear the inside of the dust cover with Girling Rubber Grease or equivalent.

Installation

1. Install mounting bolts for master cylinder at front of dash. Torque bolts to specification.
2. Connect hydraulic line at master cylinder.
3. Connect push rod at clutch pedal.
4. Install hush panel.
5. Fill master cylinder with new fluid conforming to Dot 3.
6. Raise vehicle and bleed air from system at slave cylinder as previously outlined.
7. Lower vehicle.

SLAVE CYLINDER (FIGURE 7C-11)

Removal

1. Disconnect negative cable at battery.
2. Raise vehicle.
3. Disconnect hydraulic line at slave cylinder.
4. Remove mounting bolts for the slave cylinder at clutch housing.
5. Remove the push rod and slave cylinder from the vehicle.

Disassembly

1. Remove pushrod and dust cover from the slave cylinder.
2. Remove the retaining ring.
3. Tap the slave cylinder on a block of wood to eject the piston and seal.

Replace all seals and clean the remaining parts in clean brake fluid. Inspect the cylinder bore for visible scores and ridges and check that its

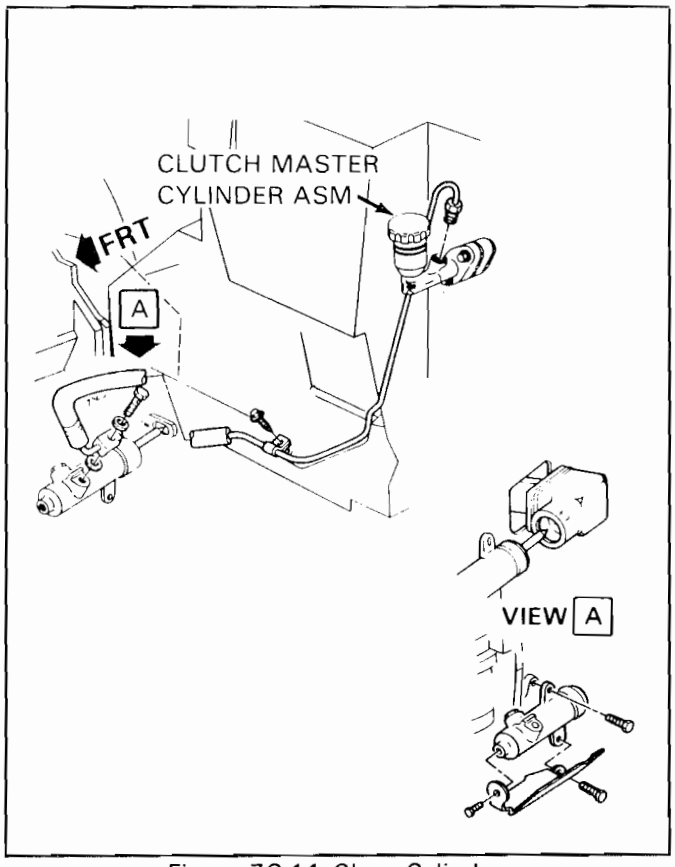


Figure 7C-11–Slave Cylinder

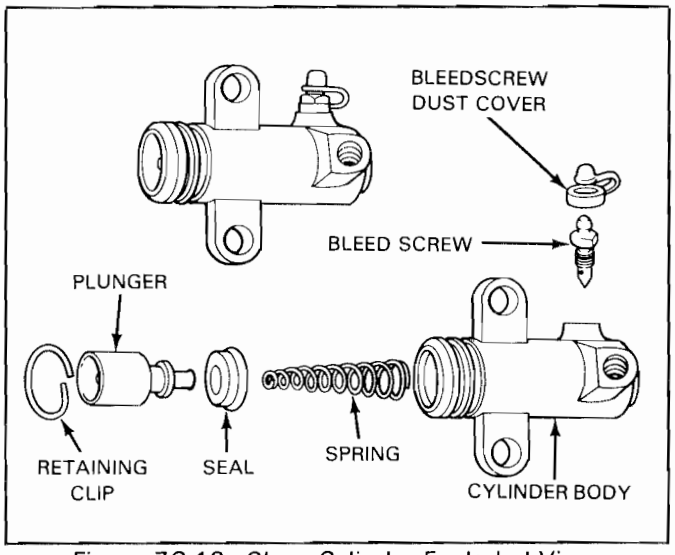


Figure 7C-12 –Slave Cylinder Exploded View

smooth to the touch. Replace the slave cylinder if any of the above condition exist.

Assembly

1. Lubricate the seal and the piston bore with new brake fluid conforming to Dot 3.
2. Position spring on piston.
3. Install the piston into the cylinder bore, easing the entrance of the plunger seal.
4. Install the retaining clip.

Installation

1. Install the hydraulic line to the slave cylinder.
2. Fill master cylinder with new brake fluid conforming to Dot 3.
3. Bleed the hydraulic system as previously outlined.
4. Install slave cylinder to clutch housing. Lubricate leading end of cylinder with Girling Rubber Lube or equivalent.
5. Lower vehicle.

PILOT BEARING (FIGURE 7C-13)

Replacement

The clutch pilot bearing is an oil impregnated type bearing pressed into the crankshaft. This bearing requires attention when the clutch is removed from the vehicle, at which time it should be cleaned and inspected for excessive wear or damage and should be replaced if necessary.

To remove, install Tool J-1448 and remove bearing from crankshaft, as shown in Figure 7C-13. In replacing this bearing, use Tool J-1522. Place bearing on pilot of tool with radius in bore of bearing next to shoulder on tool and drive into crankshaft. Lubricate with several drops of machine oil.

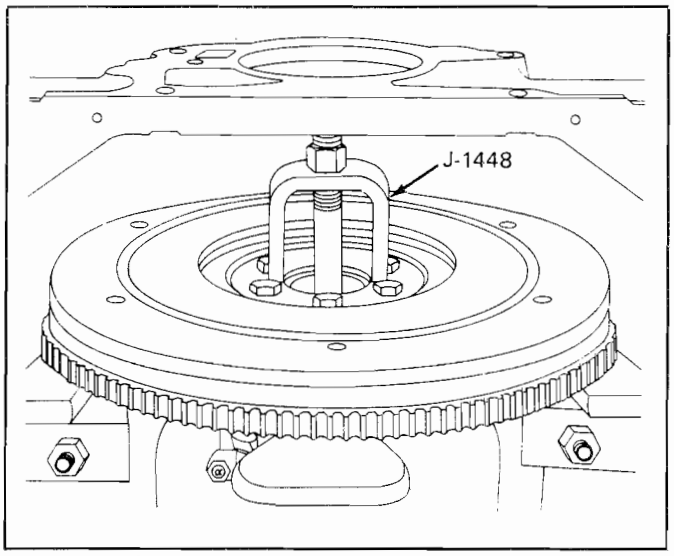
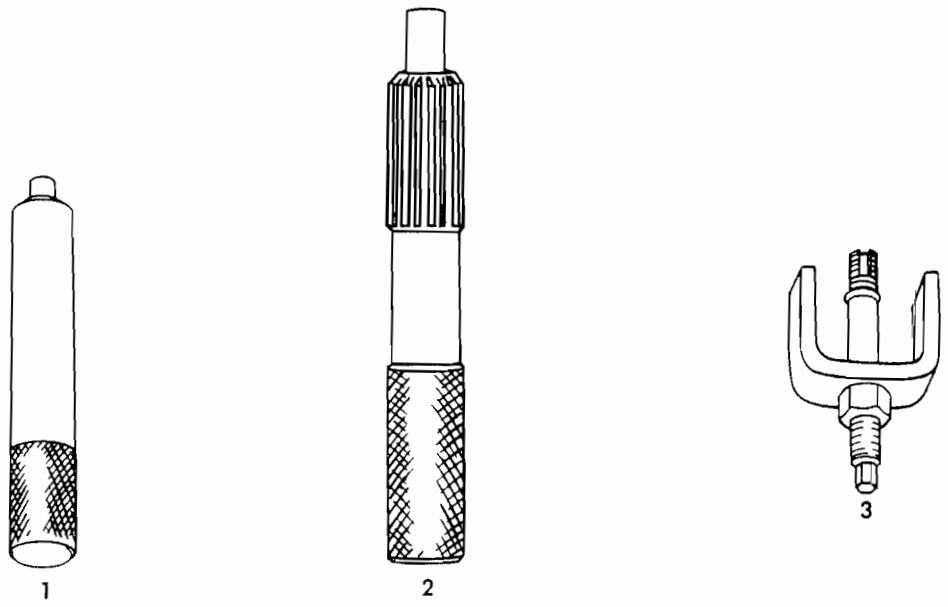


Figure 7C-13–Pilot Bearing Removal

CLUTCH PEDAL PIVOT BOLT	30-40 N·m	(22-30 FT. LBS.)
CLUTCH MASTER CYLINDER BOLTS	28-40 N·m	(20-29 FT. LBS.)
CLUTCH SLAVE CYLINDER BOLTS	40-60 N·m	(30-44 FT. LBS.)
SLAVE CYLINDER HEAT SHIELD BOLT	8-12 N·m	(6-9 FT. LBS.)
SLAVE CYLINDER BLEED SCREW	9-16 N·m	(7-11 FT. LBS.)
HYDRAULIC LINE AT SLAVE CYLINDER	34-54 N·m	(25-40 FT. LBS.)
HYDRAULIC LINE AT MASTER CYLINDER	20-27 N·m	(15-19 FT. LBS.)
FLYWHEEL BOLTS	85-115 N·m	(63-85 FT. LBS.)
PRESSURE PLATE BOLTS	34-47 N·m	(25-35 FT. LBS.)

Figure 7C-SP Specifications



1. J-1522 Pilot Bearing Driver
2. J-5824 Clutch Pilot Tool
3. J-1448 Pilot Bearing Puller

Figure 7C-ST–Special Tools

SECTION 8B

CHASSIS ELECTRICAL

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The following information will aid in diagnosis and switch and bulb replacement when used with the circuit information provided in Section 8A. All diagnostic information in this section and in Section 8A (Electrical Troubleshooting) assumes that all wires are connected and routed as designed. Disconnected and rerouted wires must be corrected or taken into account before any diagnosis can be performed.

GENERAL DESCRIPTION

LIGHTS AND LIGHTING CIRCUITS

The headlights are controlled by a light switch located on the instrument panel. This switch also controls the headlight retractors (if so equipped), parking lights, side marker lights, taillights, license plate light, instrument panel lights, and interior lights.

The parking lights, taillights, license plate light, side marker lights and instrument panel lights operate whenever the parking light switch is partially activated. The headlights turn on, in addition to lights activated by the parking light switch, when the headlight switch is fully activated. Intensity of instrument panel lights can be varied from off to bright by rotating the light switch or panel control. Rotating the control fully up past the detent will turn on passenger compartment interior lights.

A side reflex reflector is provided in the side marker lights with rear reflex installed in either the combination rear lights or backup lights.

Directional signal lights are combined with the parking lights in front and with the stop and taillights in the rear. The ignition must be "ON" for the directional signal lights to be operated with the turn signal switch.

With the directional signal switches in neutral position, stepping on the brake pedal will illuminate the rear stop lights on both sides. If the switch is operating either side as a directional signal, stepping on the brake pedal will turn on the stop light only on the side which is not flashing. The flasher used in this circuit controls only the directional signals and is located on the fuse panel.

The lane-change directional signal switch is standard equipment. When making a partial turn, such as when changing lanes, the driver has the option of moving the switch lever to a detent stop. The signal lamps will continue to flash as long as the lever is held in this position and will cancel automatically when the lever is released. By using the detent position, a shallow turn or lane change can be signaled without possibility of failure to cancel.

Moving the directional signal switch lever past the detent position to the limit of its travel for either turn will provide conventional turn signal operation. Front side marker lights, when separate from the park and turn signal lights, will flash with turn signal lights when park lights and headlights are off. When parking lights or headlights are on, the front side marker lights will flash alternately with the turn signal lights on the same side of the vehicle.

With the headlight switch in the "ON" position, the turn signal lever functions also as the headlight dimmer switch. Pulling the lever toward the driver and releasing it, switches the headlights to high or low beam.

On models with "Flash to Pass" feature, pulling the lever towards the driver will turn on the high beam headlights, as long as the lever is held in this position. This function is independent of the headlight switch operation.

A Hazard Warning flasher is included in the directional signal circuit. Pushing the switch control button (on right side of steering column) inward will disconnect the regular directional signal flasher and energize the Hazard Warning flasher regardless of ignition switch or directional signal switch position. Pulling the button collar outward will cancel the Hazard Warning flasher.

When the Hazard Warning flasher is operating, the directional signal indicator lights, and all front and rear turn signal lights will flash, as well as front side marker lights if separate from park and signal lights. If the brake pedal is depressed while the Hazard Warning flasher is operating, all signal lights will burn continuously.

The backup lights are connected to operate with the ignition "ON." This is through the neutral start switch on automatic transmission or a transmission-mounted switch on manual transmission. Placing the vehicle shift lever in "REVERSE," cycles the switch turning the backup lights on both day or night.

Most problems in vehicle lighting can be visually diagnosed and easily corrected. Problems such as bulb burnout, cracked lens, loose or cut wires, etc., constitute the majority of problems and involve only replacement of a defective or damaged part. For more difficult problems, see Diagnosis Charts.

Where removal of a part involved special procedures (lens and housing assembly sealed together, etc.), follow special instructions normally included in replacement package. Where removal of a part involves special seal items, such as seal washers under the heads of the lens retaining screws, be sure to replace items when reinstalling. Likewise, any body sealing (grommets, etc.) disturbed by wiring repairs or replacement, should be restored during service to maintain passenger compartment sealing.

The wiring harnesses use a standardized color code common to all vehicles. Under the color code, the color of the wire designates a particular circuit. The harness title indicates the type of harness, single or multiple wire, and also describes the location of the harness. Circuit Identification Charts and wiring diagrams are shown in Section 8A.

HORN

A single horn is standard on some models, while dual horns are standard on some models and optional on others.

Each horn utilizes a solenoid-actuated diaphragm to develop a resonating air column in horn projector. Diagnosis is covered in Section 8A.

A relay is used in the horn circuit because of high current required to operate horns. The relay reduces the length of heavy gage wire required and provides a more direct connection between horns and battery. Consequently, high voltage is available at the horns and better performance is obtained by eliminating voltage drop which otherwise would be in the horn button wiring circuit.

IGNITION SWITCH

The ignition switch is located in the steering column on the right hand side just below the steering wheel. The electrical switching portion of the assembly is separate from the key and lock cylinder. However, both are synchronized and work in conjunction with each other through the action of the actuator rod assembly.

For a complete explanation of the key and lock cylinder, and the actuator rod assembly, see STEERING, Section 3B.

The ignition and starting switch is key operated through the actuator rod assembly to close the ignition primary circuit and to energize the starting motor solenoid for cranking.

The ignition switch used on all cars has five positions: Two "OFF" positions ("OFF" and "OFF-LOCKED"), "ACCESSORY," "RUN" and "START." "OFF" is the center position of the key-lock cylinder, and "OFF-LOCKED" is the next position to the left.

"ACCESSORY" is located one more detent to the left of "OFF-LOCKED." Turning the key to the right of the "OFF" position until spring pressure is felt will put the ignition switch in the "RUN" position, and when turned fully to the right against spring pressure, the switch will be in the "START" position.

The connections to the ignition switch are shown in Section 8A and in the Wiring Diagrams at the end of this section. The charts included on the diagrams show how the switches are internally connected in each switch position. Fig. 8B-1 also shows how the switch is internally connected.

NEUTRAL START SWITCHES

PARK/NEUTRAL-START SWITCH

The neutral start switch, used on most models, prevents the engine from being started in gear. Some models with automatic transmission use a mechanical lock-out to prevent starting, except in "Neutral" or "Park" (see Starter/Charging Systems, Section 8A).

MANUAL TRANSMISSION - CLUTCH OPERATED START SWITCH

This system prevents starting the engine in any gear, unless the clutch is disengaged (clutch pedal depressed firmly to the floor). Installation and adjustment of switch is covered in "On-Car Service."

AUTOMATIC TRANSMISSION COMBINATION NEUTRAL/START/BACKUP LAMP SWITCH

This system, used with automatic transmission, combines the neutral start and backup lamp switches in a single switch mounted on transmission shift mechanism in the console. Adjustment of the switch is covered in "On-Car Service."

SEAT BELT WARNING SYSTEM

The seat belt warning system is the "8-SECOND-ON" system.

This system will activate a warning lamp and buzzer for approximately 8 seconds when the ignition key is turned to the "ON" position if the driver's seat belt is not buckled. *Rapid cycling of the system will result in a decrease in the time period.*

The warning lamp and buzzer with timer sequence of operation is as follows:

1. "DRIVER'S BELT UNFASTENED" Turn ignition switch "ON" - warning lamp and buzzer both come on for approximately 8 seconds, then go off and stay off. If belt buckle is fastened prior to 8 second turn-off time, buzzer will go off and warning lamp stays on for balance of 8 second delay time.
2. "DRIVER'S BELT FASTENED" Turn ignition switch "ON" - warning lamp comes on; buzzer does not. At end of approximately 8 seconds, warning lamp goes off and stays off. If buckle is unfastened prior to 8 second turn-off time, buzzer and warning lamp both stay on for balance of 8 second delay time. Warning lamp always comes on for full 8 second time, while the buzzer is controlled by the driver's seat belt buckle switch or seat belt retractor switch. Warning lamp is controlled only by ignition switch and timer.

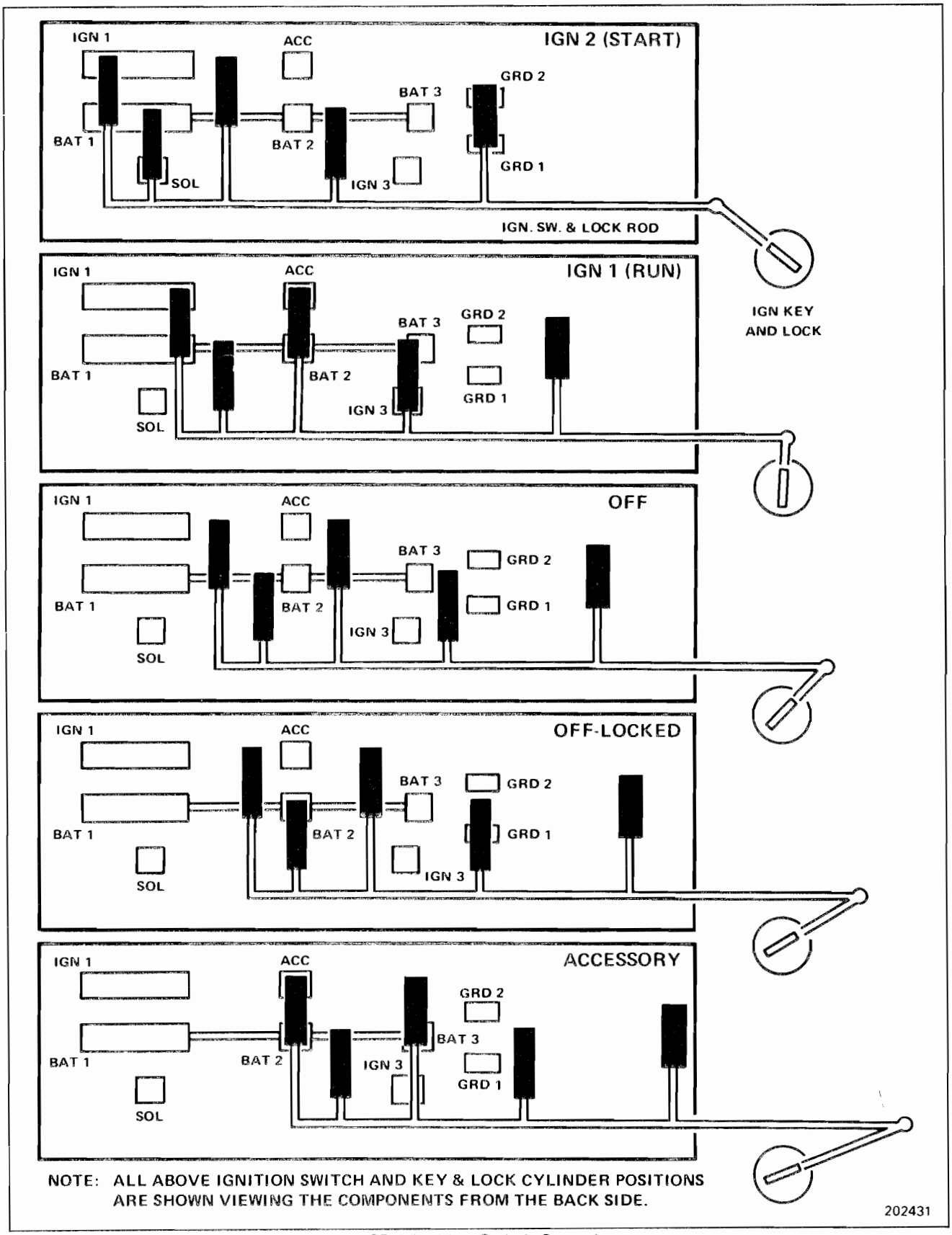


Fig. 8B-1 Ignition Switch Operation

SEAT BELT, KEY, HEADLIGHT AUDIO ALARM WARNING

Some models use an audio alarm system to remind the driver to fasten seatbelts, remove ignition key, and to turn off the headlights.

This system uses a tone generator which will sound approximately three to five times and activate a warning light on the instrument panel when the ignition key is turned to the "ON" position if the driver's seatbelt is not buckled. If the ignition key is turned to the "OFF" position and the headlights are on, the tone generator will sound (chime) to remind the driver that the headlights are on. If, however, the I.P. light dimmer thumbwheel is turned to the full "OFF" position and the headlights are "ON," the tone generator will not sound when the key is turned to the "OFF" position. If the driver's door is opened and the key is left in the ignition, the tone generator will also sound. The tone generator location is shown in "On-Car Service" and in Section 8A.

WINDSHIELD WIPER AND WASHER SYSTEM

Windshield Wiper System

The windshield wiper motor and all connecting linkage are covered in the Body Service Manual.

Electrical diagnosis of the windshield wiper system is covered in Section 8A.

Controlled cycle wiper systems are covered in the Accessory Section.

Standard Washer System

The washer system is a pulse system which operates for a pre-determined number of pulses when the washer button is depressed or a continuous-run system that provides fluid as long as the washer button is depresed.

Refer to Sections 3B and 9 and replacement of multi-function switch mounted in steering column.

Any time washer nozzles must be replaced, insure that the spray pattern falls within the area shown in Figures 8B-2 and 8B-3.

Fluidic Washer System

Some models use a fluidic windshield washer system. The system consists of a fluid container, pump, wiper motor, fluidic hoses and pipes, nozzle mounts, nozzle(s) and wiper arms.

The fluidic washer system is controlled by a small plastic element designed into the washer nozzle. As water is forced through this insert, the design of the mechanism creates an oscillating power stream. This fluidic washer system produces larger, more widely dispersed droplets, resulting in a more efficient cleaning action than with conventional spray nozzles.

A correctly operating system should deliver a spray patter just below the lower edge of the windshield upper reveal molding. The bottom edge of the spray pattern should fall on a line about 254mm (10") below the upper edge of the windshield (Fig. 8B-2).

Spray pattern level can be adjusted by shimming as shown in "On-Car Service."

If the nozzles become plugged, they can be serviced only by replacement (see Section 4 in the "BODY" portion of this manual). Pump and wiper motor service remain unchanged.

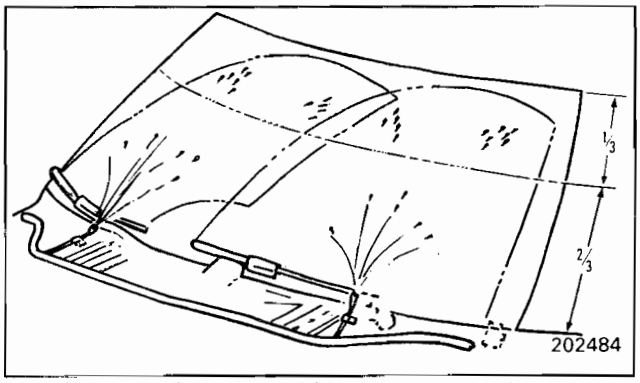


Fig. 8B-2 Windshield Washer Target Area

Standard Washers

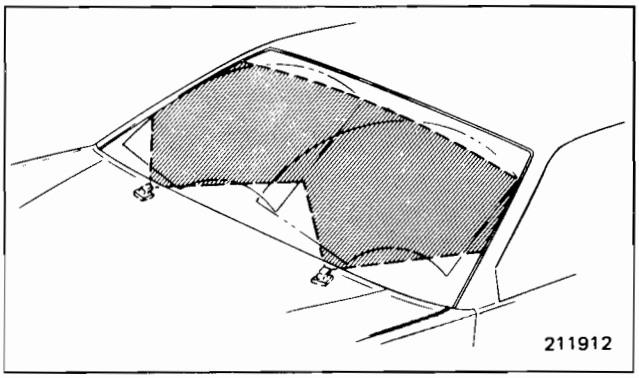


Fig. 8B-3 Windshield Washer Target Area - Fluidic Nozzles

FUSE BLOCK

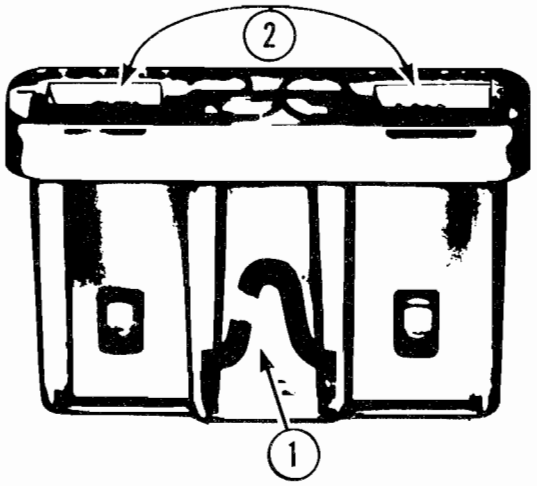
The fuse block on some models is a swing-down unit located in the underside of the instrument panel adjacent to the steering column. Access to the fuse block on some models is gained through the glove box opening. All models use a fuse block for miniaturized fuses, designed for increased circuit protection and greater reliability. Various convenience connectors, which snap-lock into the fuse block, add to the serviceability of this unit. Location of fuse block and fuse usage and specifications for specific models is covered in Section 8A.

A miniaturized fuse is used with the fuse block. This compact fuse, with blade terminal design, allows fingertip removal and replacement. Fuses of different ratings are physically interchangeable, **but** amperage values are molded in bold, color coded, easy-to-read numbers on the fuse body. Be sure that only fuses of proper ratings are used for replacement. Replacing a fuse with one of a higher than recommended value is not recommended.

A suspected blown fuse can easily be pulled out and examined (see Fig. 8B-4). The clear plastic body gives full view of the element to blade construction for visual checking for defects. In addition, blade terminal tips are exposed in the fuse body, allowing for continuity checking if desired.

FUSIBLE LINK

Added protection is provided in all battery feed circuits and other selected circuits by a fusible link. This link is a



TO TEST FOR BLOWN MINI-FUSE:

(1) PULL FUSE OUT AND CHECK VISUALLY.

(2) WITH THE CIRCUIT ACTIVATED, USE A TEST LIGHT ACROSS THE POINTS SHOWN.

MINI-FUSE COLOR CODES

RATING	COLOR
5 AMP	TAN
10 AMP	RED
20 AMP	YELLOW
25 AMP	WHITE

203309

Fig. 8B-4 Blown Fuse

short piece of copper wire approximately 4" long inserted in series with the circuit and acts as a fuse. The link is four (4) or more gages smaller in size than the circuit wire it is protecting and will burn out without damage to the circuit in case of current overload. The chassis electrical wiring diagrams at the end of this section show the locations and colors of these fusible links.

CONVENIENCE CENTER

The Convenience Center on some models is a swing-down unit located on the underside of the instrument panel. The swing-down feature provides central location and easy access to buzzers, relays and flasher units. All units are serviced by plug-in replacement. Location of Convenience Center on specific models is covered in Section 8A.

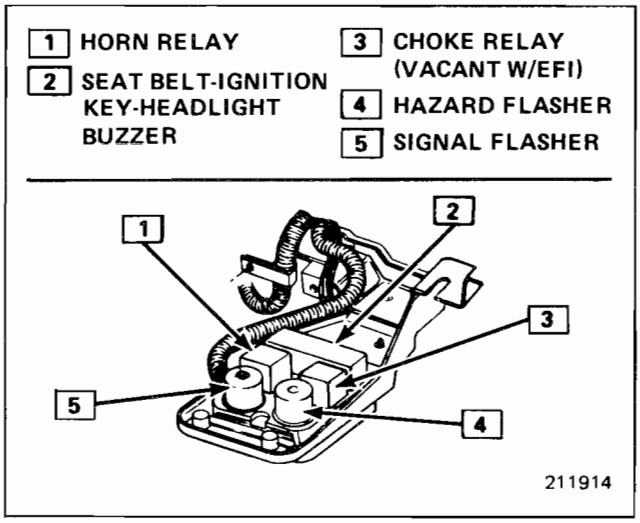


Fig. 8B-5 Convenience Center and Components - Typical

DIAGNOSIS - LIGHTS AND LIGHTING CIRCUITS

Troubles in the lighting circuits are caused by loose connections, open or shorted wiring, burned out bulbs, failed switches, inadequate ground, or blown fuses. In each, trouble diagnosis requires following through the circuits until the source of difficulty is found. To aid in making an orderly check, refer to the wiring diagrams shown in Section 8A, Electrical Troubleshooting.

Servicing of headlight retractor systems used on models with concealed headlights is covered in Section 2C.

HEADLIGHT DIAGNOSIS

Condition	Possible Cause	correction
One headlight inoperative or intermittent	1. Loose connection	1. Secure connections to sealed beam including ground (black wire)
	2. Defective sealed beam unit.	2. Replace sealed beam.
One or more headlights are dim.	1. Open ground connection at headlight.	1. Repair black wire connection between sealed beam and body ground.
	2. Black ground wire mislocated in headlight connector (three-wire, hi-lo, connector only)	2. Relocate black wire in connector.
One or more headlights	1. Charge circuit	1. Refer to Section 6D,

short life	problem.	charging system diagnosis.
All headlights inoperative or intermittent	1. Loose connection.	1. Check and secure connections at dimmer switch and light switch.
	2. Defective dimmer switch.	2. Check voltage at dimmer switch with test light. Refer to Section 8A for test points.
	3. Open wiring - light switch to dimmer switch.	3. Check yellow wire with test light. If bulb lights at light switch yellow wire terminal but not at dimmer switch, repair open wire.
	4. Open wiring - light switch to battery.	4. Check red wire terminal at light switch with test light. If bulb does not light, repair open red wire circuit to battery (possible open fusible link).
	5. Shorted ground circuit.	5. If, after a few minutes operation, headlights flicker "ON" and "OFF" and or a thumping noise can be heard from the light switch (circuit breaker opening and closing), repair short to ground in circuit between light switch and headlights. After repairing short, check for headlight flickering after one minute operation. If flickering occurs, the circuit breaker has been damaged and light switch must be replaced.
	6. Defective light switch.	6. Check red and yellow wire terminals at light switch with test light. If bulb lights at red wire terminal but not at yellow terminal, replace light switch.
Upper or lower beam will not light or intermittent.	1. Open connection or defective dimmer switch.	1. Check dimmer switch terminals with test light. If bulb lights at light green or tan wire terminals, repair open wiring between dimmer switch and headlights. If bulb will not light at either of these terminals, depending upon switch position, replace dimmer switch.

	2. Short circuit to ground.	2. Follow diagnosis above (all headlights inoperative or intermittent)

SIDE MARKER LIGHT DIAGNOSIS

Condition	Possible Cause	Correction
One light inoperative	1. Turn signal bulb burnt out (front light)	1. Switch turn signals on. If signal bulb does not light, replace bulb. (Bulb filament provides ground path for marker lamp bulb through the dark blue or brown wires.)
	2. Side marker bulb burnt out.	2. Replace bulb.
	3. Loose connection or open in wiring.	3. Using test light, check brown wire terminal at bulb socket. If test bulb lights, repair open ground circuit. If bulb does not light, repair open in brown wire circuit.
Front or rear lights inoperative.	1. Loose connection or open ground circuit.	1. If associated tail or park lights do not operate, check all connectors in brown wire circuit. If park and turn lights inoperative, repair open ground connections.
	2. Multiple bulbs burnt out.	2. Replace burnt out bulbs.
All lights inoperative	1. Blown fuse	1. If park and taillights do not operate, replace blown fuse. If new fuse blows, check for short to ground between fuse panel and lights.
	2. Loose connection	2. Secure connector to light switch.
	3. Open in wiring	3. Check taillight fuse with test light. If test bulb lights, repair open wiring between fuse and light switch. If not, repair open wiring between fuse and battery. (Possible open fusible link.)
	4. Defective light switch	4. Check light switch with test light. If test bulb lights at orange wire but not at brown wire, replace light switch.

TAIL, PARK AND LICENSE LIGHT DIAGNOSIS

Condition	Possible Cause	Correction
One side inoperative	1. Bulb burnt out	1. Replace bulb.
	2. Open connection at at bulb socket or ground wire terminal	2. Jumper bulb base socket connection to ground. If bulb lights, repair open ground circuit.
Both sides inoperative	1. Tail light fuse blown	1. Replace fuse. If new fuse blows, repair short to ground in brown wire circuit between fuse panel through light switch to lights.
	2. Loose connection	2. Secure connector at light switch.
	3. Open wiring	3. Using test light, check circuit on both sides of fuse. If test bulb does not light on either side, repair open circuit between fuse panel and battery (possible open fusible link). If test bulb lights at light switch brown wire terminal, repair open wiring between light switch and lamps.
	4. Multiple bulb burnout	4. If test bulb lights at lamp socket brown wire terminal, replace bulb(s).
	5. Defective light switch	5. If test bulb lights at light switch orange wire but not at brown wire, replace defective light switch.

TURN SIGNAL AND HAZARD WARNING LIGHT(S)

Condition	Possible Cause	Correction
Turn signals inoperative one side	1. Bulb(s) burnt out (flasher cannot be heard)	1. Turn hazard warning system "ON." If one or more bulbs are inoperative, replace bulbs as necessary.
	2. Open wiring or ground connector	2. Turn hazard warning system on. If one or more bulbs are inoperative, use test light and check circuit at bulb socket. If test bulb lights, repair open ground connection. If not, repair open wiring between bulb socket and turn signal switch.

	3. Improper bulb or defective turn signal switch.	3. Turn hazard warning system on. If all front and rear lights operate, check for improper bulb (see bulb chart). If bulbs are OK, replace defective turn signal switch.
	4. Short to ground. (Flasher can be heard, no bulbs operate)	4. Locate and repair short to ground by disconnecting front and rear circuits separately.
Turn signals inoperative	1. Blown turn signal fuse	1. Turn hazard warning system on. If all lights operate, replace blown fuse. If new fuse blows, repair short to ground between fuse and lamps.
	2. Defective flasher (located in convenience center near steering column)	2. If turn signal fuse is OK and hazard warning system will operate lights, replace defective turn signal flasher.
	3. Loose connection	3. Secure steering column connector.
Hazard Warning Inoperative	1. Blown stop-hazard fuse	1. Switch turn signals "ON." If lights operate, replace stop-hazard fuse if blown. If new fuse blows, repair short to ground. (Could be in stop light circuit.)
	2. Defective hazard warning flasher. (Located in convenience center).	2. If stop-hazard fuse is OK, switch turn signals on. If lights operate, replace defective hazard flasher.
	3. Open in wiring or defective turn signal switch.	3. Using test light, check brown wire in turn signal steering column connector. If test bulb does not light, repair open circuit between flasher and connector. If test light indicates power on brown wire and connection is good, use test light to check output terminals (lt. blue, blue, yellow and dark green wires) see Section 8A.

BACKUP LIGHT

Condition	Possible Cause	Correction
One light inoperative or intermittent	1. Loose or burnt out bulb.	1. Secure or replace bulb.
	2. Loose connection	2. Tighten connectors.
	3. Open ground connections.	3. Repair bulb ground circuit.
Both lights inoperative or intermittent.	1. Gear selector switch misadjusted (open when shifter lever is in reverse position)	1. Readjust gear selector switch.
	2. Loose connection or open circuit	2. Check all connectors. If OK, check continuity of circuit from fuse to light on either side of fuse, correct open circuit from battery to fuse.
	3. Blown fuse	3. Replace fuse. If new fuse blows, repair short to ground in circuit from fuse through gear selector or from fuse through gear selector or backup light switch to backup lights.
	4. Defective gear selector or backup light switch	4. With ignition "ON," check switch terminals in backup position with test light. If test bulb lights at dark blue wire terminal but not at light green wire terminal, replace light switch.
	5. Defective ignition switch	5. If test bulb lights at ignition switch battery terminal but not as output terminal, replace ignition switch.
Light will not turn off	1. Gear selector switch misadjusted (closed when shift lever is not in reverse position)	1. Readjust gear selector switch.

STOP LIGHTS

Condition	Possible Cause	Correction
One bulb inoperative	1. Bulb burnt out.	1. Replace bulb.
One side inoperative (multi-bulb design)	1. Loose connection, open wiring or defective bulbs.	1. Turn on directional signal. If light does not operate, check bulbs. If bulbs are OK, check all connections.

		If light still does not operate, use test light and check for open wiring.
	2. Defective directional signal switch or cancelling cam	2. If light will operate by turning directional signal on, the switch is not centering properly during cancelling operation. Replace defective cancelling cam or directional signal switch.
All stop lights inoperative	1. Stop-hazard fuse blown	1. Replace fuse. If new fuse blows, repair short to ground in circuit between fuse and lights.
	2. Open in wire from fuse to stop-switch	2. Check for power at brown wire at stop-switch and at fuse. If there is power at fuse but not at switch, check for open in brown wire.
	3. Stop-switch misadjusted or defective	3. With brake pedal depressed, check white wire terminal in steering column connector with test light. If bulb does not light, check stop switch for proper adjustment. If adjustment is OK, jumper stop switch. If stop lights operate, replace stop switch.
Will not turn off	1. Stop switch misadjusted or defective	1. Readjust switch. If switch still malfunctions, replace.

ON-CAR SERVICE

MAINTENANCE

Maintenance of the lighting units and wiring system consists of an occasional check to see that all wiring connections are tight and clean, that the lighting units are tightly mounted to provide good ground and that the headlights are properly adjusted. Loose or corroded connections may cause a discharged battery, difficult starting, dim lights, and possible damage to generator and charging circuit. Wire harnesses must be replaced if insulation becomes deteriorated. Whenever it is necessary to splice a wire or repair one that is broken, always use rosin core solder to bond the splice. Use insulating tape to cover all splices or bare wires.

When replacing wires, it is important that the correct gage size be used. Never replace a wire with one of a smaller gage size.

Each harness and wire must be held securely in place by clips or other holding devices to prevent chafing or wearing of the insulation due to vibration.

By referring to the wiring diagrams, circuits may be tested for continuous circuit or shorts with a conventional test light or low reading voltmeter.

WIRING HARNESS SERVICE AND REPAIR

Special connectors known as Weather-Pack connectors (Fig. 8B-6) require a special tool (J-28742) for servicing. This special tool is required to remove the pin and sleeve terminals. If removal is attempted with an ordinary pick, there is a good change that the terminal will be bent or deformed. Unlike standard blade-type terminals, these terminals cannot be straightened once they are bent.

Make certain that the connectors are properly seated and all of the sealing rings in place when connecting leads. The hinge-type flap provides a backup, or secondary locking feature for the terminals. They are used to improve the connector reliability by retaining the terminals if the small terminal lock tangs are not positioned properly.

Molded-on connectors require complete replacement of the connection. This means splicing a new connector assembly into the harness. Environmental connections cannot be replaced with standard connections. Instructions are provided with Weather-Pack connector and terminal packages.

With the low current and voltage levels found in some circuits, it is important that the best possible bond at all wire splices be made by soldering the splices as shown in Fig. 8B-7.

Use care when probing the connections or replacing terminals in them, it is possible to short between opposite terminals. If this happens to the wrong terminal pair, it is possible that damage may be done to certain components. Always use jumper wires between connectors for circuit checking. **Never** probe through the Weather-Pack seals.

When diagnosing for possible open circuits, it is often difficult to locate them by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may correct the open circuit condition. This should always be considered when an open circuit is indicated while troubleshooting. Intermittent problems may also be caused by oxidized or loose connections.

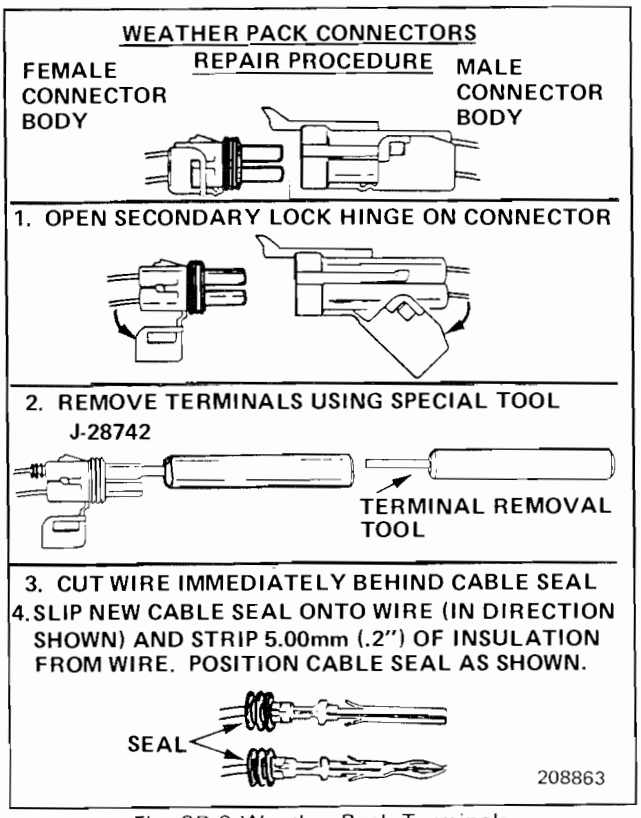


Fig. 8B-6 Weather-Pack Terminals

FUSIBLE LINK-REPLACEMENT

Remove and Replace

1. Disconnect battery.
2. Located burned out link. This may require use of the chassis wiring diagrams in Section 8A.
3. Strip away all melted harness insulation.
4. Cut burned link ends from circuit wire.
5. Strip circuit wire back approximately 1/2" to allow soldering of new link.
6. Using fusible link four (4) gages smaller than protected circuit (approximately 10" long), solder new link into circuit.

NOTICE: *Use only resin core solder. Under no circumstances should an acid solder be used nor should link be connected in any other manner except by soldering. Use of acid core solder may result in corrosion.*

7. Tape soldered ends securely using suitable electrical tape.
8. After taping wire, tape harness leaving an exposed loop of wire approximately 5" in length.
9. Reconnect battery.

FRONT LIGHTING ADJUSTMENTS

LIGHT AIMING

The front lights (headlights, fog lights, driving lights, etc.) must be properly aimed in order to provide maximum allowable road illumination. When using mechanical aimers, follow equipment manufacturers instructions.

Front lights should be checked for proper aim at new car predelivery, every 12 months, after installing a new sealed beam unit or if front end sheet metal is adjusted or repaired. Replacement of a bulb in a nonsealed beam unit will normally not require unit aiming readjustment. Aiming of headlights can be performed without removing headlight bezels (Figure 8B-8).

Horizontal and vertical aiming of each headlight sealed beam unit is provided by two (2) adjusting screws which move the mounting ring in the body against the tension of the coil spring. There is no adjustment for focus since the sealed beam unit is set for proper focus during manufacturing assembly.

Some state and local authorities have specific requirements for front light aiming adjustments and these requirements should be followed.

CONCEALED HEADLIGHTS

General Description

The concealed headlights used on this model are electrically operated. Each headlight uses a permanent magnet motor which raises and lowers the headlight.
When the headlights are turned on, relays attached to the actuators activate the motors.

If an electrical failure should occur in the headlight circuit, the headlights may be raised manually by rotating the knob on the motor in the counterclockwise direction. The headlights may be lowered by rotating the knob in the clockwise direction.

NOTICE: In order to use the above procedure, there must not be any voltage at the motor terminals. This can be accomplished by disconnecting the electrical connections at the isolation relay.

HALOGEN BULB CAUTION

CAUTION: TO HELP AVOID PERSONAL INJURY
- **PROTECT YOUR EYES**
- **KEEP DIRT AND MOISTURE OFF BULB**
- **AVOID TOUCHING THE BULB GLASS**
- **DO NOT OPERATE THE BULB WHEN OUT OF THE HOUSING**
- **DISCARD BULB BY PLACING IN CARTON**

THE BULB CAN SHATTER AND THE LAMP BECOMES VERY HOT.

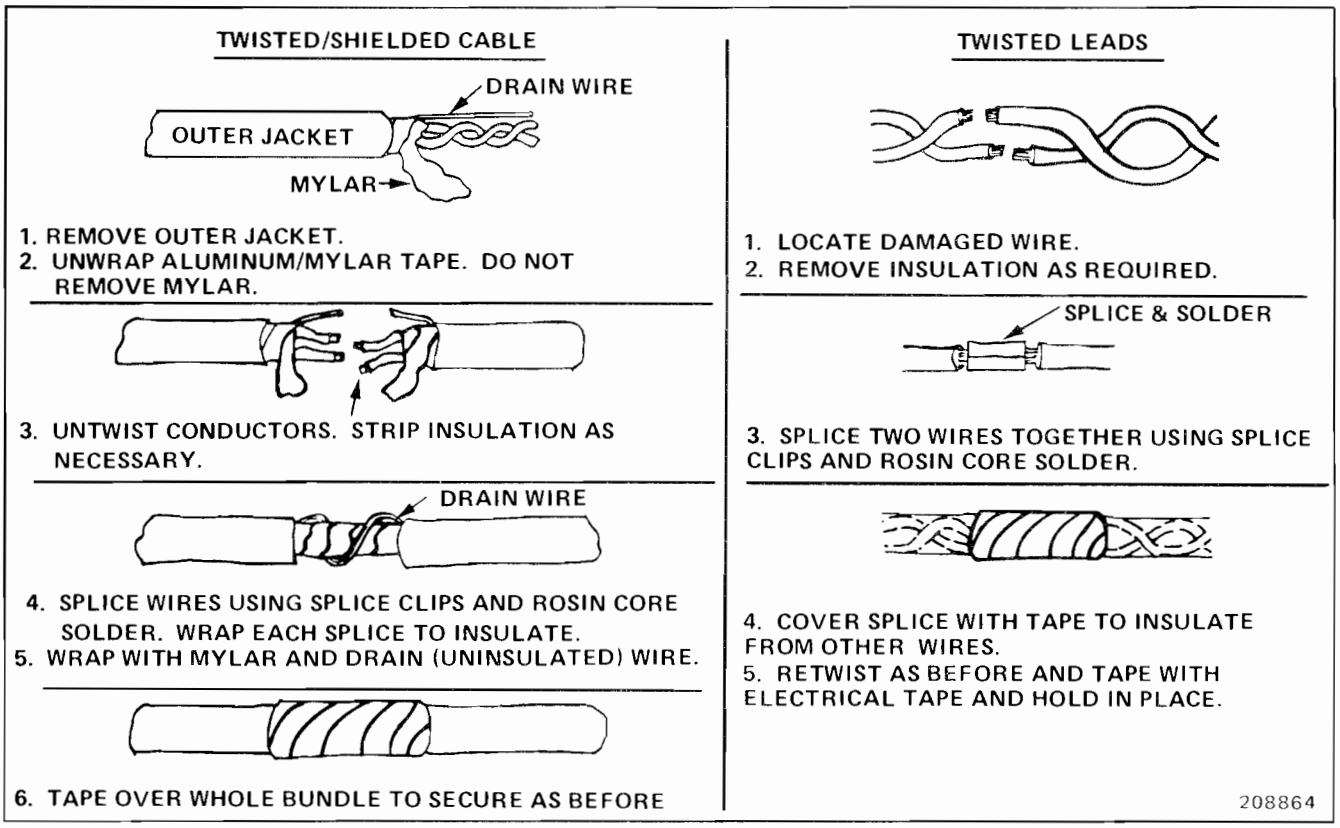


Fig. 8B-7 Wiring Repair

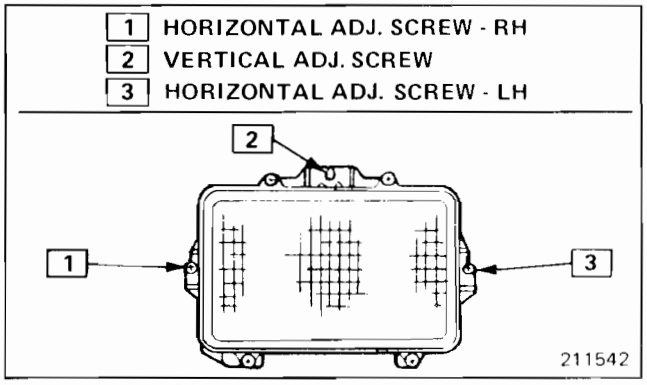


Fig. 8B-8 Headlight Aiming Screws

Illustrations referenced in the removal/replacement procedures covered here are shown in Figures 8B-9 thru 8B-31.

Headlamp Assembly (Fig. 8B-9)

Removal

1. Open hood and actuate headlamp switch to headlamps open position.
2. Disconnect battery ground cable.
3. Remove 4 (four) nuts, headlamp assembly to hood, 1 (one) carriage bolt and nut.
4. Remove 2 (two) screws) headlamp assembly to hood (at front of headlamp)
5. Disconnect headlamp and motor connectors.
6. Headlamp assembly may now be removed for further disassembly. (Refer to Figure 8B-9).
7. Reverse removal procedure to install.

HEADLIGHT (Fig. 8B-9)

Replacement

1. Remove the headlight bezel by removing the four (4) attaching screws.
2. With a hooked tool, such as a cotter pin remover, pull the retaining spring to one side to release the headlight.
3. Rotate the right headlight clockwise to release it from the aiming pins. Rotate the left headlight counterclockwise to release it.
4. Remove the electrical connector.
5. Remove the retaining ring.
6. Install the new sealed beam unit in the retaining ring and install it on the vehicle by reversing the previous procedure.

SIDE MARKER LIGHT

Replacement (Figure 8B-10)

The bulb socket is reached from the front under the front fender.

1. Turn bulb socket counterclockwise 90° and pull out.
2. Remove bulb from socket and insert new bulb, then check operation of lamp.
3. Replace bulb socket in lamp housing and turn clockwise 90° to lock in place.

FOG LPS, FRONT PARK/TURN SIGNAL LIGHT

Replacement (Figure 8B-12)

1. To replace light bulb, lift hood, reach behind light assembly and remove twist-lock socket and replace bulb.
2. To replace light housing, it will be necessary to remove the front bumper facia as outlined in Section 2B, Bumpers. The lamp housing attaching screws will then be accessible. Remove two attaching screws, remove twist lock socket and replace housing.

INTERIOR LIGHTS AND SWITCHES

IGNITION SWITCH

Due to the integral design relationship of the ignition switch with steering column, service procedures for ignition switch are given in Section 3A, Steering.

LIGHTING SWITCH

See Section 8C.

MULTI-FUNCTION SWITCH

Replacement

Due to the integral design relationship of the multi-function switch (windshield wiper/washer, headlight beam selector and directional signal) with steering column, service procedures for multi-function switch are given in Section 3A, Steering.

HEADLIGHT WARNING BUZZER

Replacement

Headlight warning buzzer (audio alarm) is a plug-in unit mounted in the swing-down convenience center located behind the I.P. to the right of the steering column. See Section 8A and 8C for details.

STOP LIGHT SWITCH

Replacement (Fig. 8B-27)

Remove left hush panel.

1. Reach up under instrument panel at the brake pedal support and release wiring harness connector at switch.
2. Pull switch from mounting bracket.
3. Depress brake pedal and push replacement switch into clip until shoulder on switch bottoms out against clip.
4. Adjust stop light switch by bringing brake pedal to normal rest position. Electrical contact should be made when the brake pedal is now depressed 13.5mm (0.53 inch) from its fully released position. If adjustment of the switch is necessary, the switch may be rotated (or pulled) in the clip.

BACKING LIGHT SWITCH-MANUAL TRANSMISSION

Replacement

1. Raise vehicle on hoist, with brake set.
2. Pull electrical connector from switch (located at rear of the transmission).
3. Remove switch from the transmission case.
4. Install new backup light switch and gasket.
5. Push on electrical connector and lower vehicle.
6. Turn on ignition switch and place transmission in reverse detent to check operation of backup lights.

NEUTRAL/START SWITCH-AUTOMATIC TRANSMISSION

Replacement (Figure 8B-24)

1. Remove floor console cover (see Section 8C).
2. Disconnect electrical connectors on backup/neutral start switch.
3. Place shift lever in NEUTRAL position of detent plate.
4. Remove two (2) screws securing neutral starter switch and remove switch.
5. Make sure shift lever is in NEUTRAL position of detent plate before installing replacement neutral/start switch.
6. Place replacement neutral/start switch in position on shift lever making sure pin on shift lever is in slot of neutral/start switch and secure switch with two (2) screws. Tighten switch screws to 1.6-2.2 N•m (14-19 in. lbs.).
7. Move shift lever out of NEUTRAL position to shear plastic shear pin.
8. Connect electrical connectors to switch. Apply parking brake and start vehicle. Check to make sure vehicle starts only in PARK or NEUTRAL position. Check that backup lamps are on when shift lever is in REVERSE position. Check that seat belt warning system operates.
9. Turn off ignition and install floor console cover.

Installation If Shear Pin Has Been Sheared (also readjustment)

Make sure shift lever is in NEUTRAL position of detent plate.

1. Loosen two (2) switch attaching screws.
2. Align hole in contact carrier with hole in back of switch and insert 2.34mm (0.092 inch) diameter gage pin in both holes.
3. Place neutral/start switch in position on shift lever making sure pin on shift lever is in slot of neutral/start switch and secure switch with two (2) screws. Tighten switch screws to 1.6-2.2 N•m (14-19 in. lbs.).
4. Remove gage pin before moving shifter out of NEUTRAL position.
5. Connect electrical connectors to switch. Apply parking brake and start vehicle. Check to make sure vehicle starts only in PARK or NEUTRAL position. Check that backup lamps are on when shift lever is in REVERSE position. Check that seat belt warning system operates.
6. Turn off ignition and install floor console cover.

CLUTCH OPERATED, NEUTRAL/START SWITCH - MANUAL TRANSMISSION

Replacement (Figure 8B-3)

The clutch pedal must be fully depressed and the ignition switch in START position for the vehicle to start.

1. Disconnect electrical connector from switch.
2. Remove bolt and switch from clutch bracket. Rotate switch slightly so that actuating shaft retainer can be pulled from hole of clutch pedal.
3. Place new switch in position so that actuating shaft retainer is in line with hole of clutch pedal and reinstall bolt.
4. Connect electrical connector to switch.
5. Depress clutch pedal fully to the floor to adjust switch. Clutch operated starting switch is self-adjusting. If readjustment is required, depress detent on adjuster block and slide block to full forward position on switch rod. Depress clutch pedal fully to the floor to adjust switch.

PARK BRAKE WARNING SWITCH

Replacement (Figure 8B-23)

1. Remove console top trim cover (see Section 8C).
2. Remove park brake lever (see Section 5).
3. Disconnect electrical connector at switch.
4. Remove screw securing switch to park brake lever and remove switch.
5. Place replacement switch in position making sure locating tab of switch is in locating hole of parking brake lever.
6. Secure switch with screw, tightening screw to 2.2-3.4 N•m (22-35 in. lbs.).
7. Connect electrical connector at switch.
8. Install park brake lever (see Section 5).
9. Install console top trim (see Section 8C).

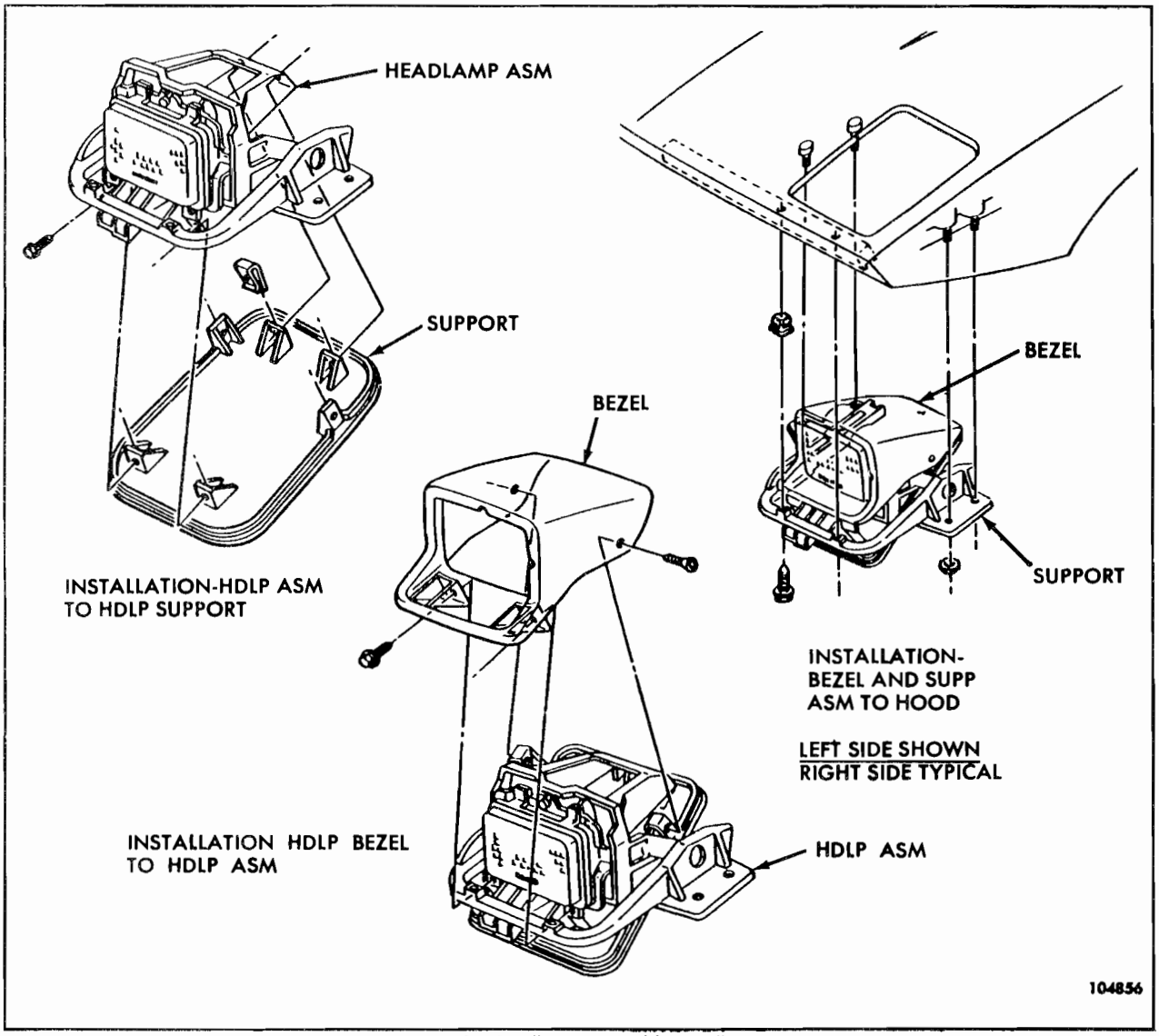


Fig. 8B-9--Headlamp Assembly Installation

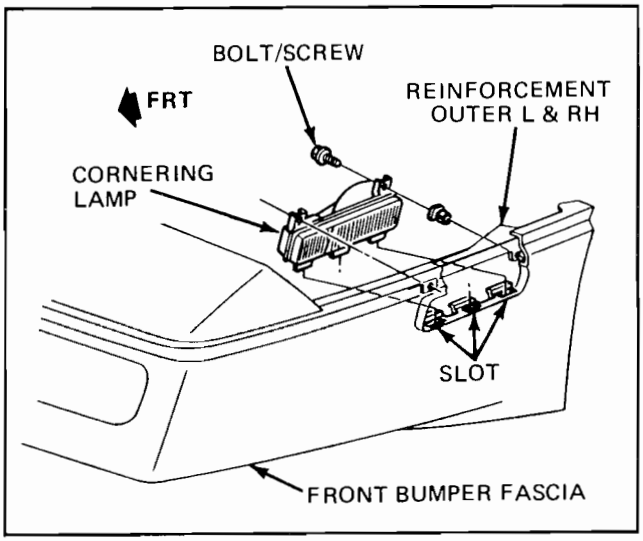


Fig. 8B-10--Cornering Lamp, Side Marker Lamp Assy.

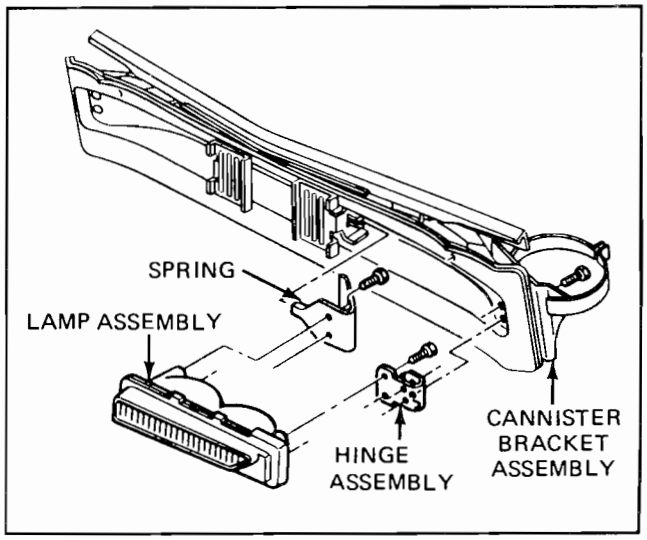


Fig. 8B-12--Fog Lamp, Directional Lamp Assy.

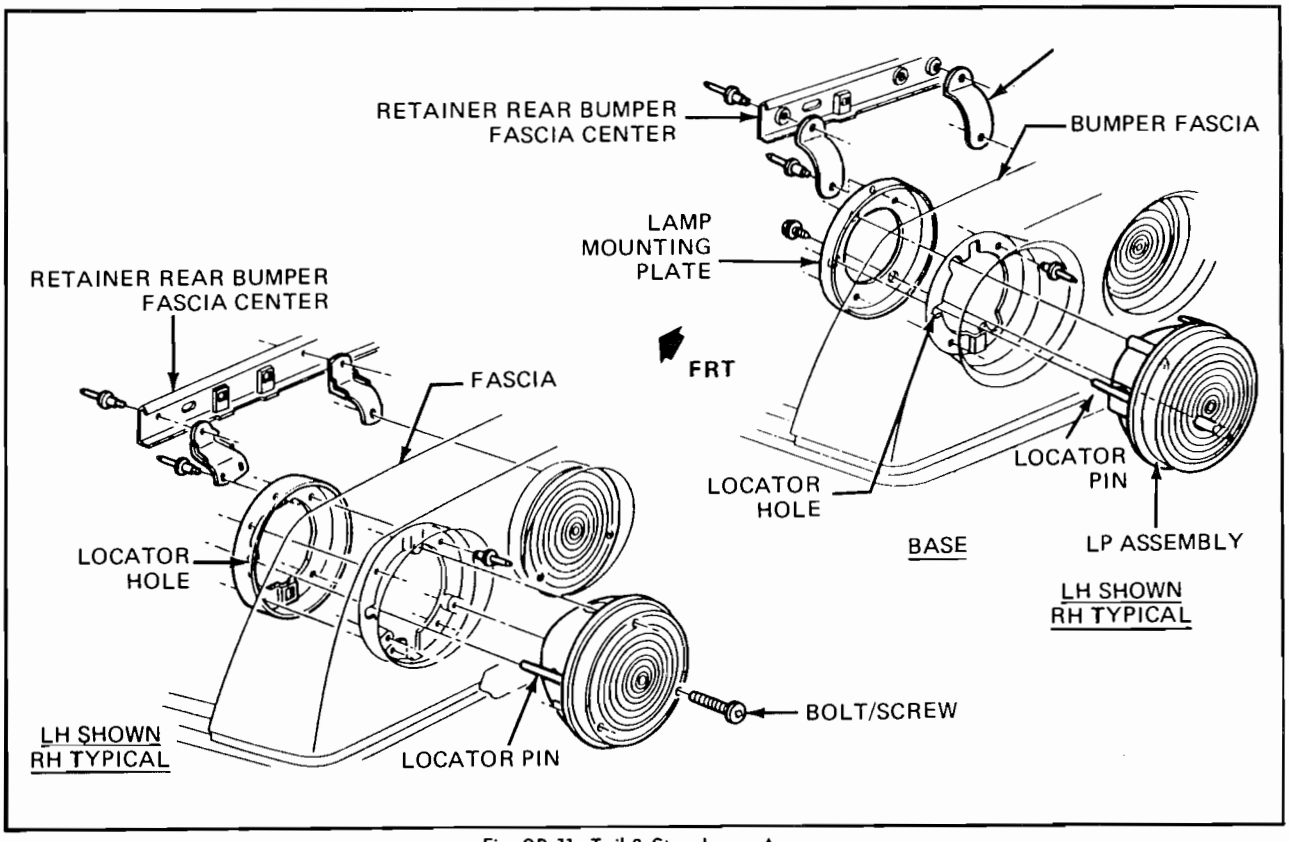


Fig. 8B-11--Tail & Stop Lamp Assy.

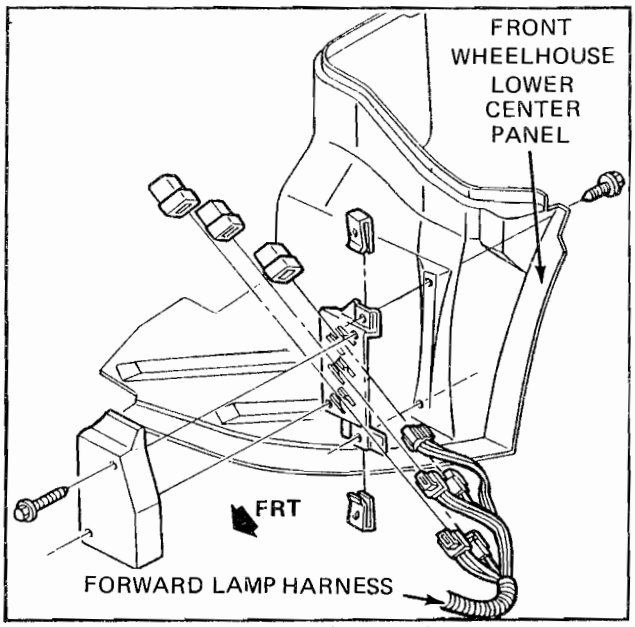


Fig. 8B-13--Head Lamp Relays

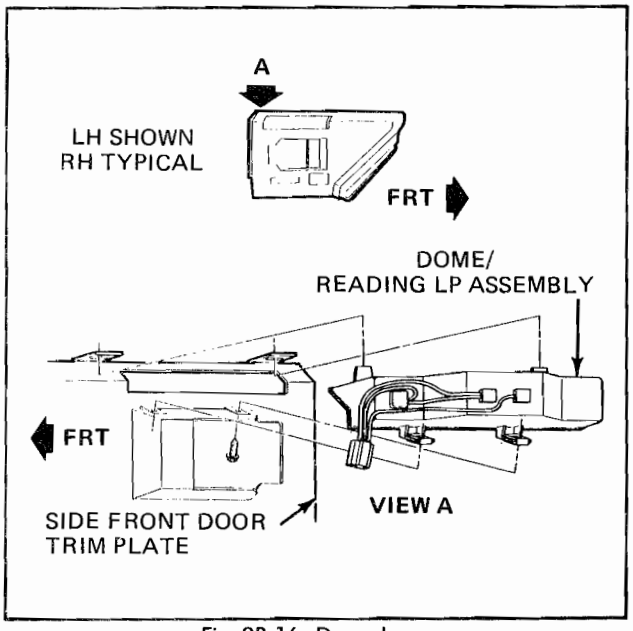


Fig. 8B-16--Dome Lamp

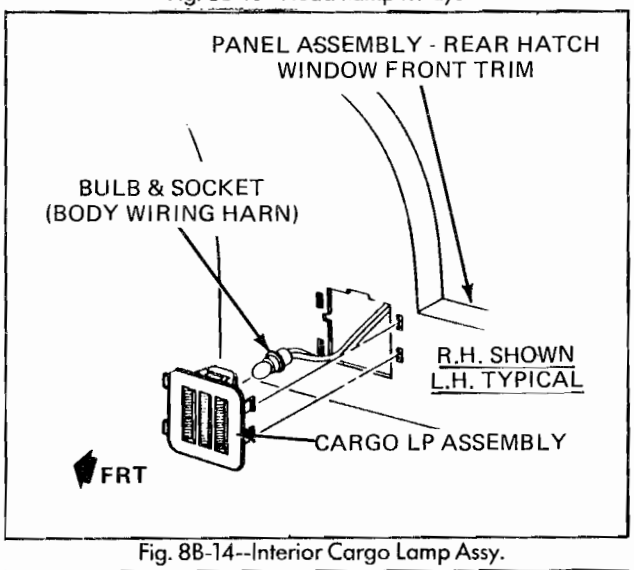


Fig. 8B-14--Interior Cargo Lamp Assy.

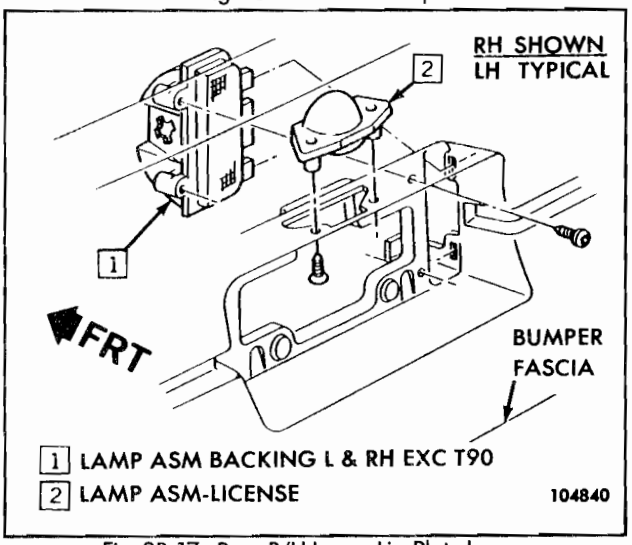


Fig. 8B-17--Rear B/U Lamp, Lic. Plate Lamp

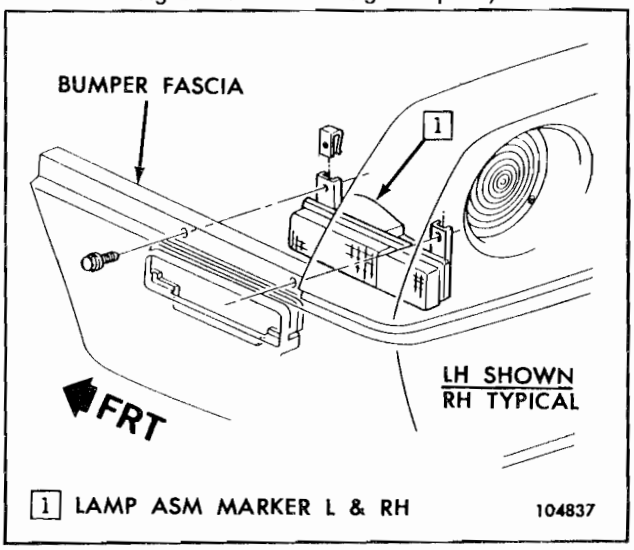


Fig. 8B-15--Rear Side Marker

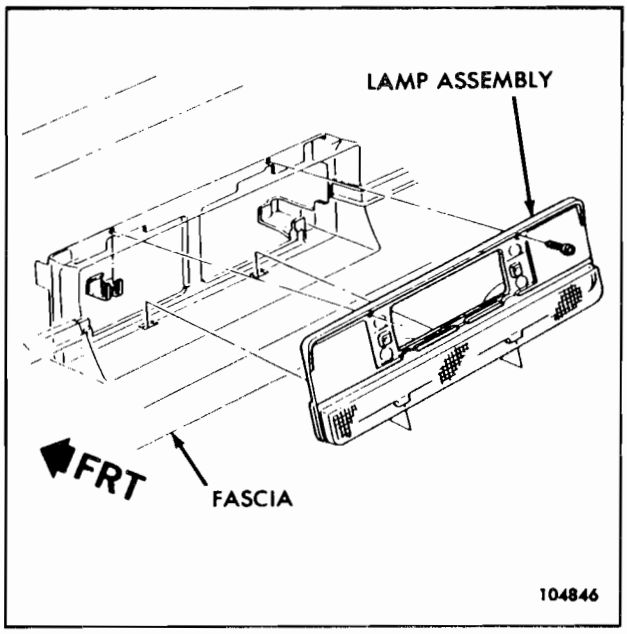


Fig. 8B-18--B/U Lamp Lisc. Lamp Assy./VD1

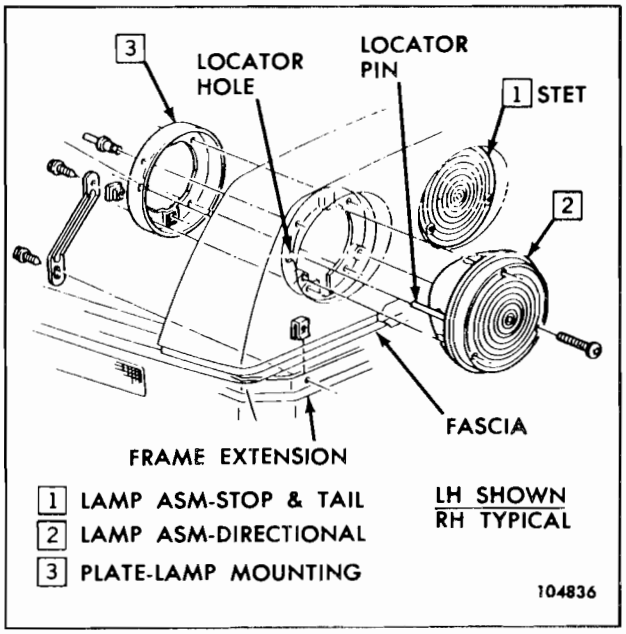


Fig. 8B-19--Rear Tail Lamp VD1/VE1/VT7

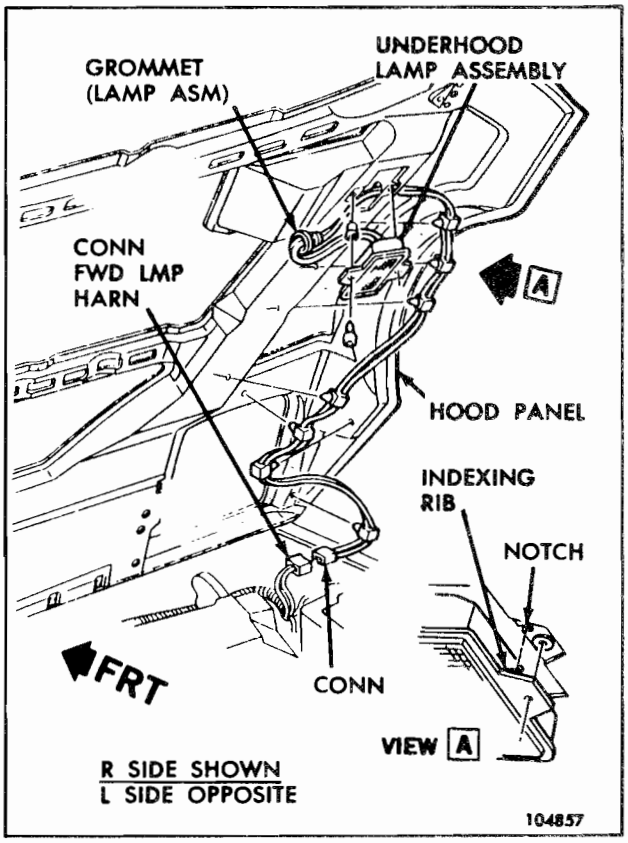


Fig. 8B-20--Under Hood Lamp Assy.

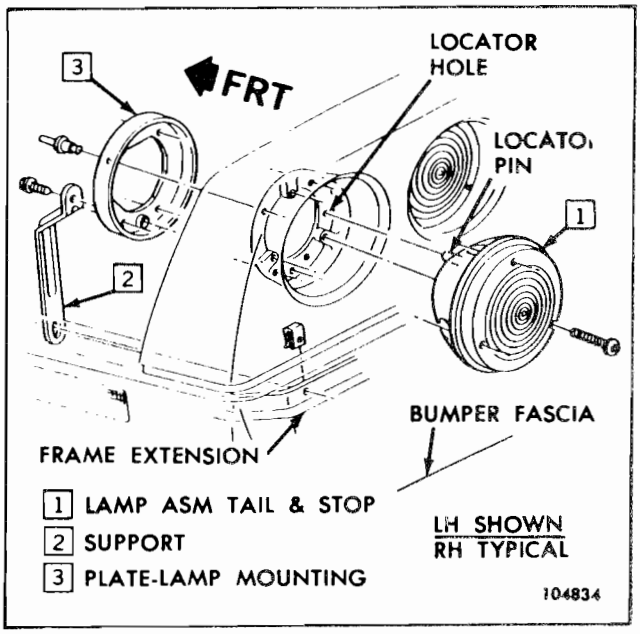


Fig. 8B-21--Rear Lamps, Tail & Stop

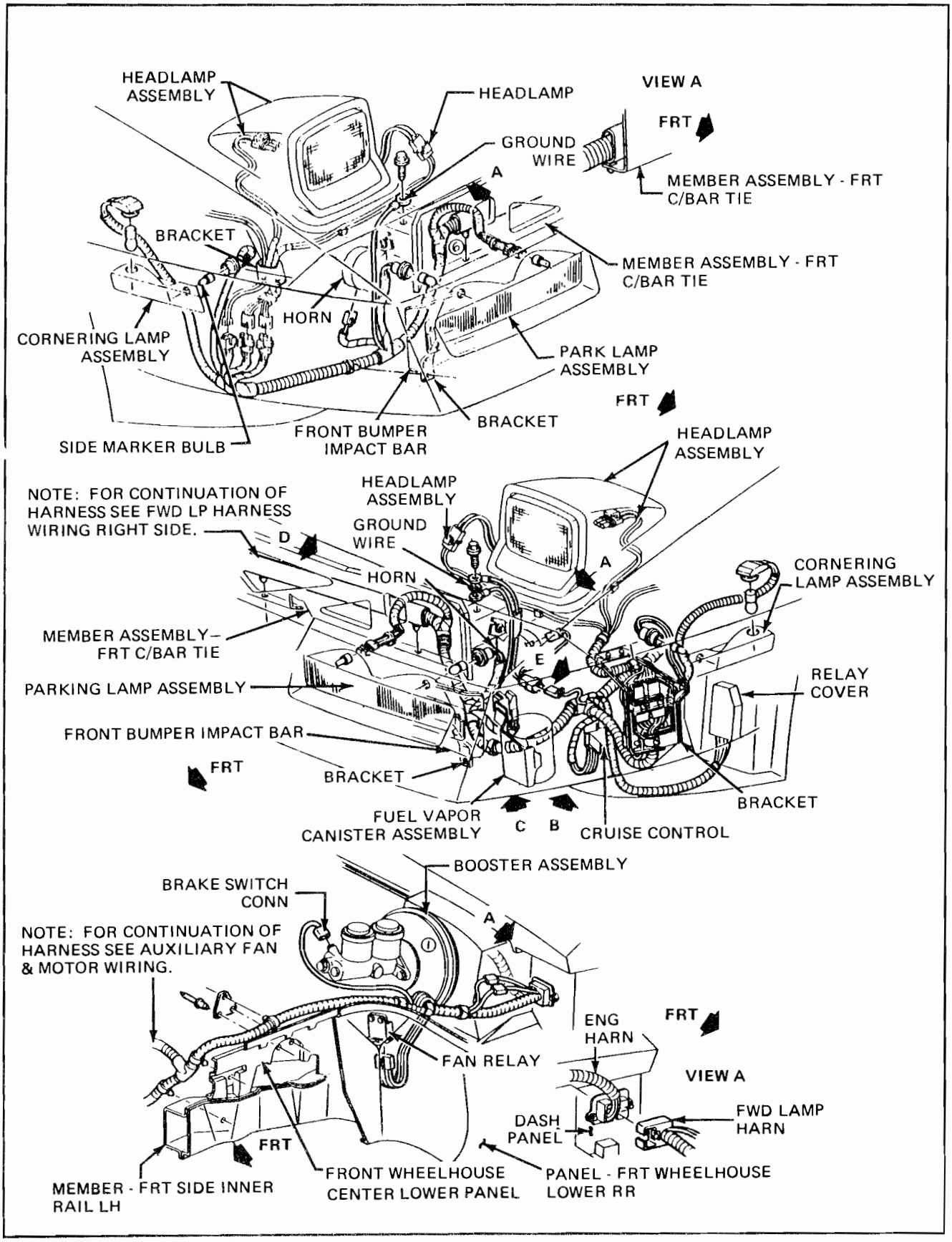


Fig. 8B-22--Forward Lamp Wiring

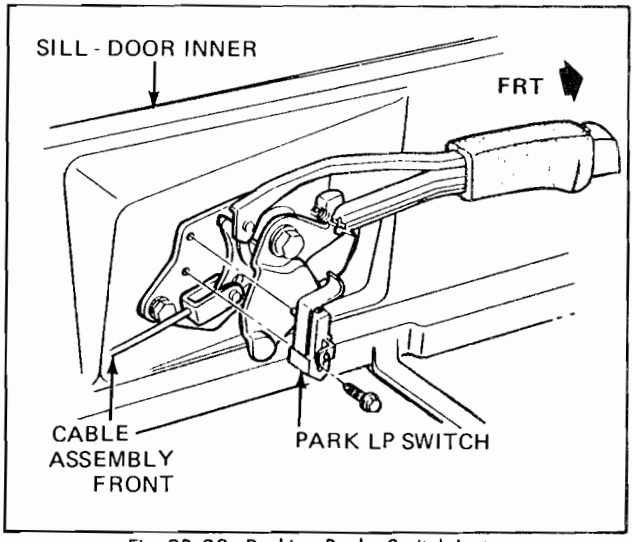


Fig. 8B-23--Parking Brake Switch Inst.

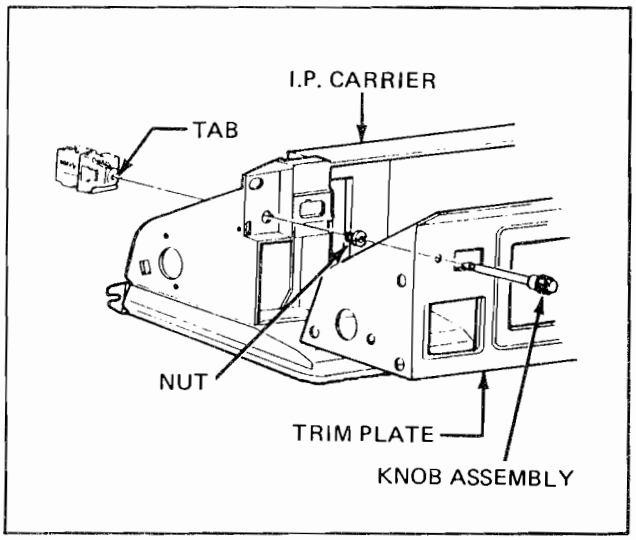


Fig. 8B-26--Head Lamp Switch

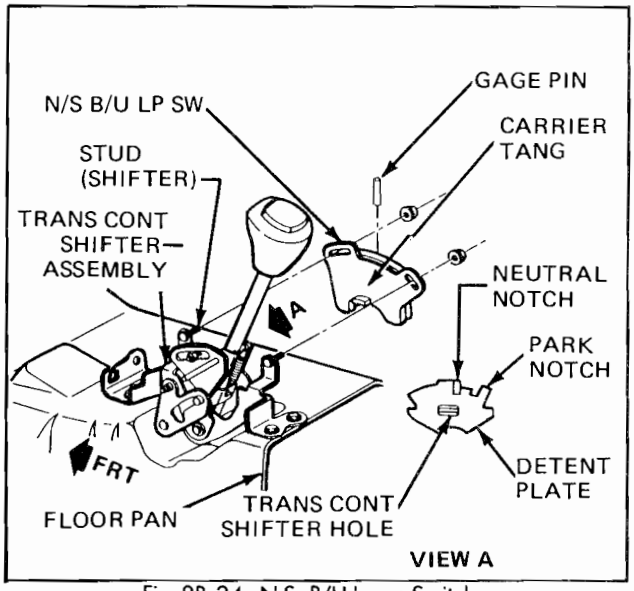


Fig. 8B-24--N.S.-B/U Lamp Switch

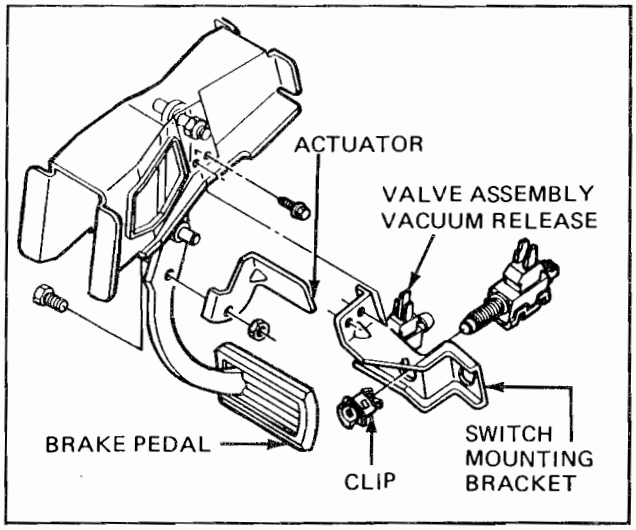


Fig. 8B-27--Stop Lamp Switch

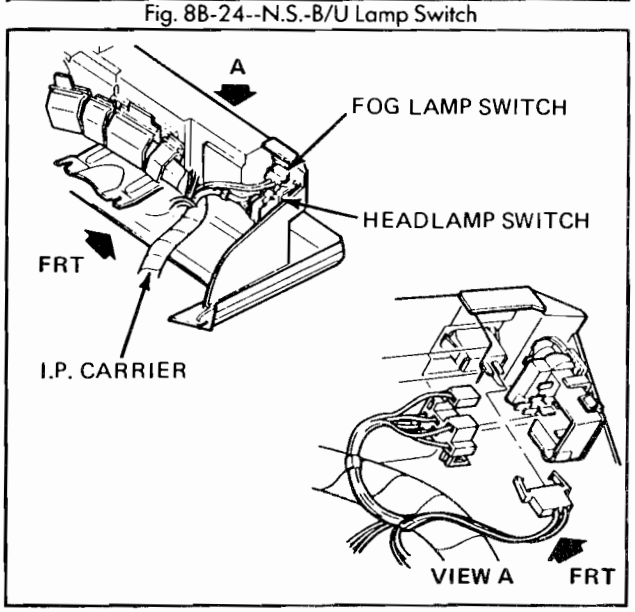


Fig. 8B-25--I.P. to Headlamp Switch & Fog. Lamps, Harn

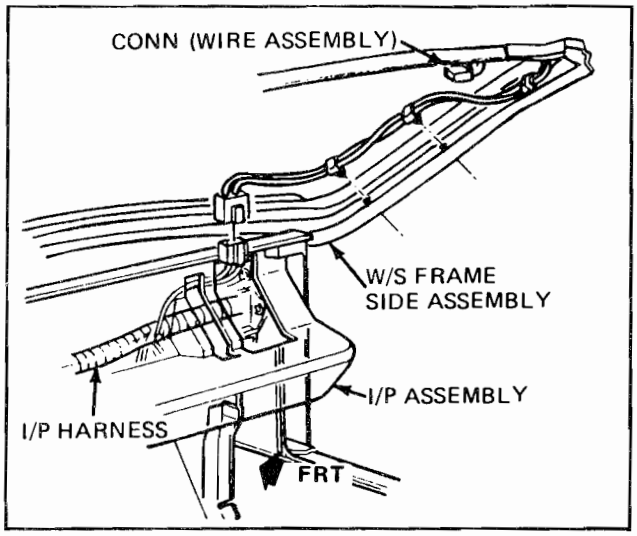


Fig. 8B-28--Vanity Mirror Wiring

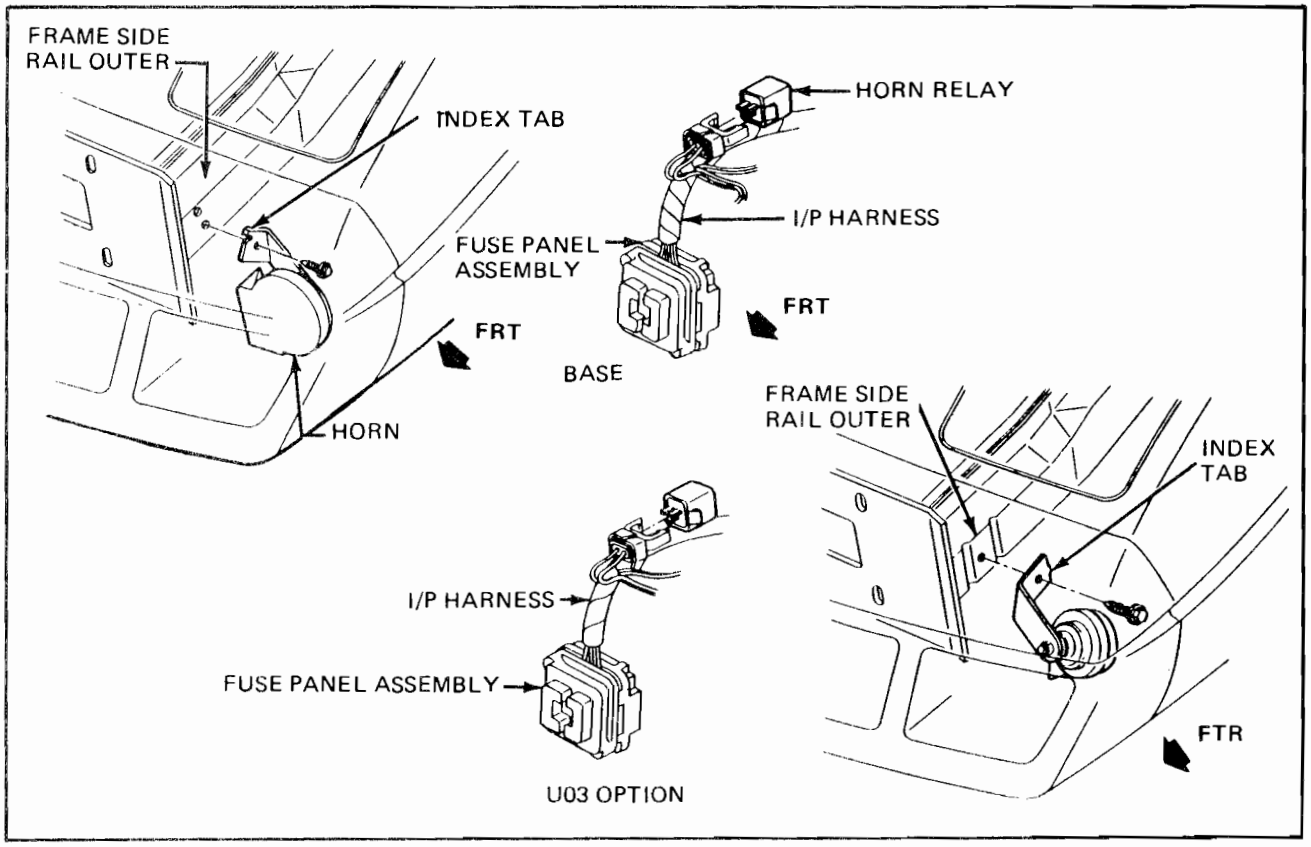


Fig. 8B-29--Horn & Relay

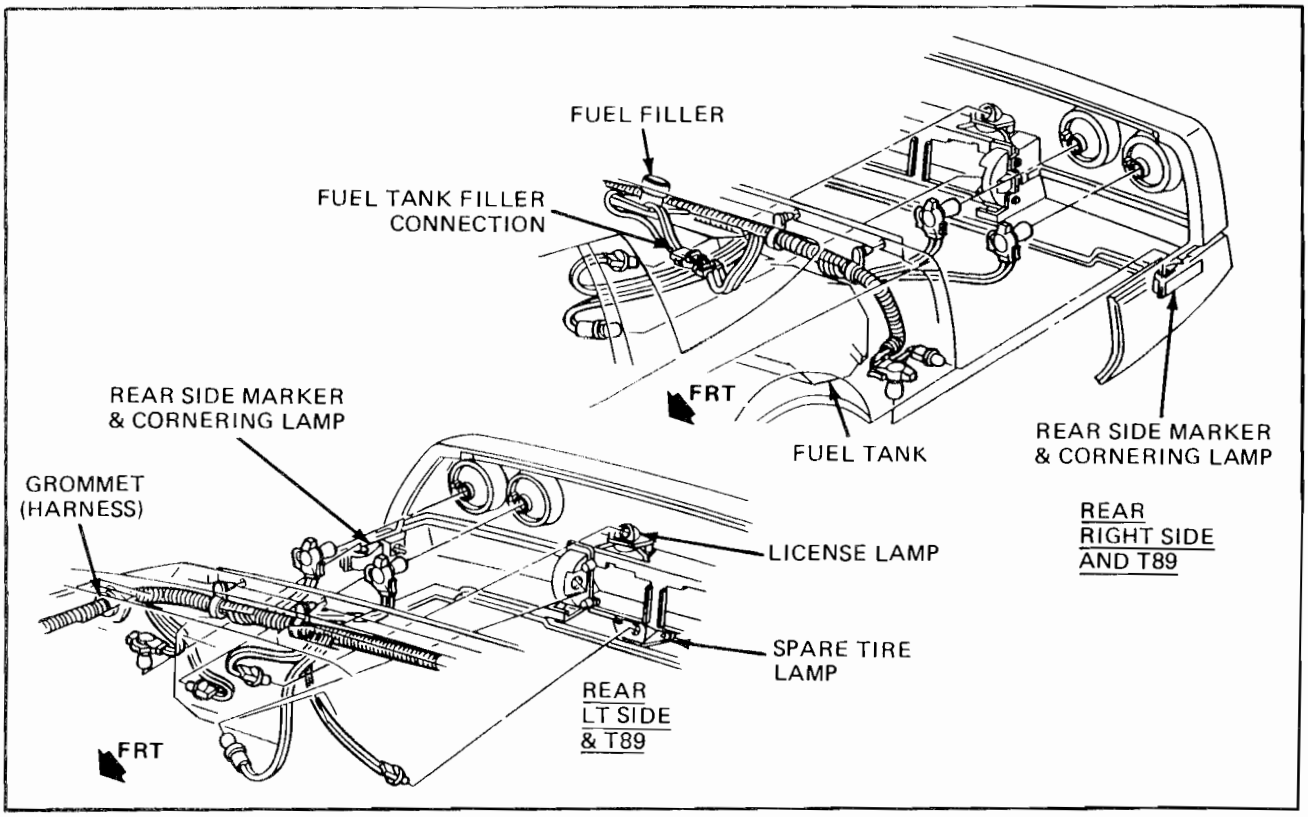


Fig. 8B-30--Rear Body Wiring

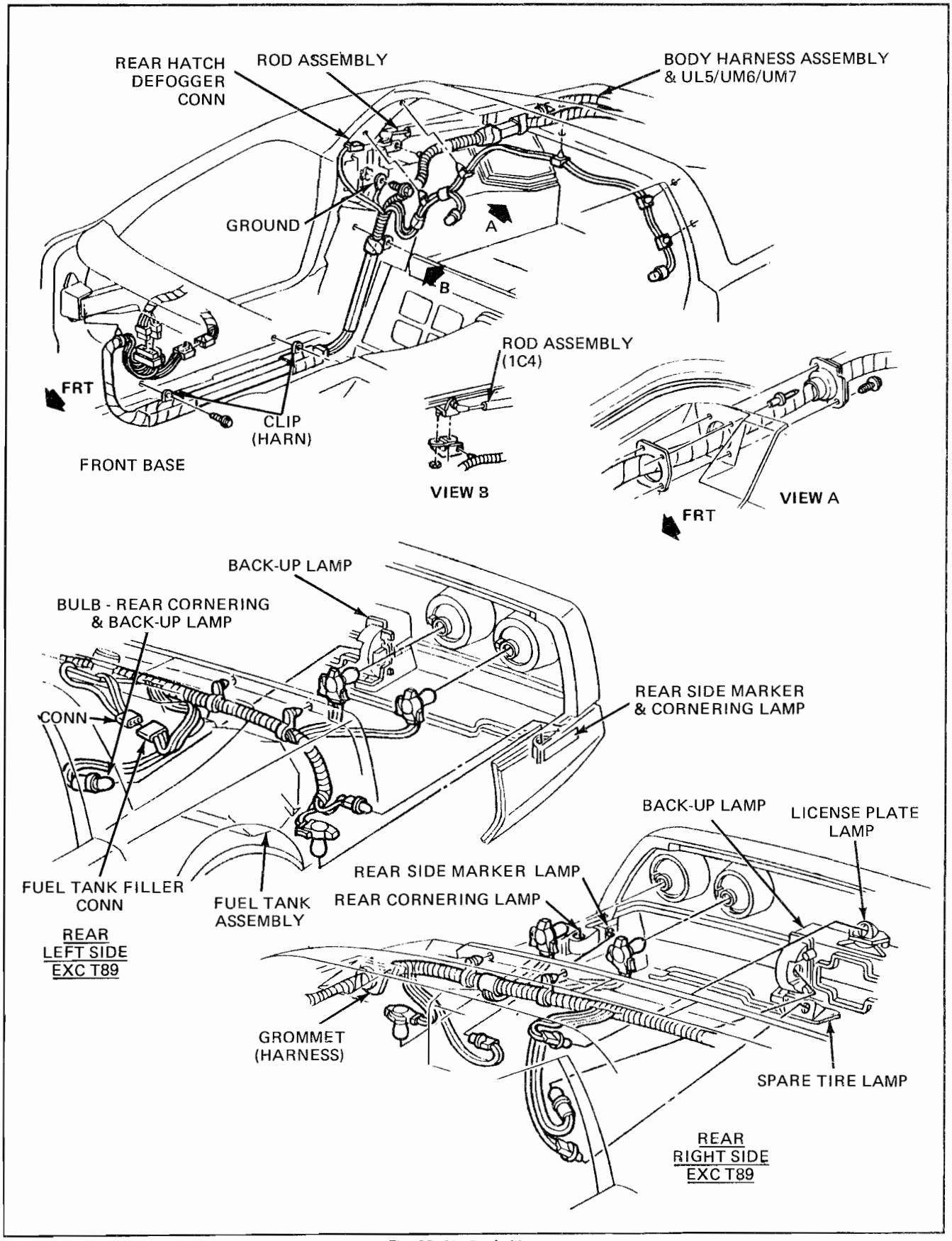


Fig. 8B-31--Body Harness

SPECIFICATIONS

APPLICATION	LAMP/ BULB NO.	NO. USED	RATING, CANDLE POWER OR (WATTS)
FRONT			
CORNERING	1156	2	32
FOG	*880	2	27 W
HEADLAMP	H6054	2	35W/65W
PARK & DIRECTIONAL SIGNAL	2057NA	2	2.4/1.5
SIDE MARKER	194	2	2
REAR			
BACK-UP	1156	2	32
CORNERING	1156	2	32
LICENSE	194	1	2
SIDE MARKER	194	2	2
SPARE TIRE	194	1	2
STOP, TAIL & DIRECTIONAL SIGNAL	2057	4	32/2
INTERIOR ILLUMINATION			
AIR COND./HEATER CONTROL	37	2	0.5
AUTO. TRANS. INDICATOR	194	1	2
CONSOLE COMPARTMENT	564	1	2
COURTESY			
– CARGO LAMP	906	2	6
– DOOR	212-2	2	6
– FLOOR	563	2	4
INSTRUMENT CLUSTER			
– TACHOMETER & SPEEDO-METER	882	4	3.8
– CONSOLE	161	2	1
RADIO	37	2	0.5
UNDERHOOD	211-2	2	12
VISOR VANITY MIRROR	74	2	0.7
WIPER/WASHER CONTROL	194	1	2
WARNING LIGHTS & INDICATORS			
BRAKE	194	1	2
CHECK ENGINE	194	1	2
DOOR AJAR	194	1	2
HATCH AJAR	194	1	2
HEADLAMP HIGH BEAM	74	1	0.7
OVERDRIVE	194	1	2
SEAT BELT	194	1	2
SECURITY	194	1	2
TURN SIGNAL INDICATOR	74	2	0.7
TURN SIG. FLASHER – 3 LAMP TYPE			

SECTION 8C

INSTRUMENT PANEL AND GAGES

CONTENTS

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GENERAL DESCRIPTION

A detailed description of the cluster and its operation is included in Section 8A (Electrical Troubleshooting) of this manual.

INSTRUMENT PANEL

Instrument panel component layout is shown in Figure 8C-1.

The instrument cluster (Figure 8C-2) used on this vehicle is an electronic, microprocessor controlled liquid crystal display type. Speedometer and tachometer readings are displayed digitally and in bar graph forms. A driver information center, located between the speedometer and tachometer, has an analog fuel gage display and four multifuction digital displays. The four digital displays are switch selectable as follows:

- Oil Pressure or Oil Temperature
- Coolant Temperature or System Voltage
- Instant or Average Fuel Economy
- Trip Odometer, Range or Distance Traveled on Reverse

A telltale panel (Figure 8C-3), located to the right of the cluster (above the console), contains telltale indicators for low fuel, oil temp, low oil pressure, coolant temp, and low system voltage which are activated under out of normal range conditions.

To the left of the telltale panel is a function select switch panel (Figure 8C-5) which contains four function select switches, an English/Metric select switch, a trip odometer/range reset button, and an average fuel economy reset button.

A photocell located on the face of the cluster provides ambient lighting information to the cluster circuitry which in turn adjusts panel illumination as necessary.

OPERATION

When the ignition is turned "on", all displays light with full brillance for two seconds or for full duration of the crank position (whichever is longer). Then all analog displays cycle full scale and back to normal reading in two seconds. Digital readings associated with the analog readouts also cycle to normal.

SPEEDOMETER DISPLAY

The speedometer display incorporates both analog (bar graph) and digital readouts. The speedometer signal is produced from a transmission mounted PM generator. The display is programmed for either English or Metric readouts.

TACHOMETER DISPLAY

The tachometer display incorporates both analog (bar graph) and digital display. The tachometer signal is produced from the HEI distributor.

DRIVER INFORMATION CENTER (FIGURE 8C-4)

Fuel Display

The fuel gage display is an analog (bar graph) readout with markings on the bar graph at "E" (empty), and "F" (full). This is the only display in the Driver Information Center that is not affected by the English/Metric switch or the function select switches.

A "low" fuel telltale and on-reverse features associated with this display are incorporated whenever the last bar of the fuel bar graph goes out.

Oil Pressure/Temperature Display

The oil temperature/pressure display located in the Driver Information Center is a three digit display. It is capable of displaying either oil pressure or oil temperature in both English or metric units (as selected by the function select switches), along with the corresponding legends, ISO symbols, and a telltale.

A teltale feature has been incorporated in this display for both oil pressure and oil temperature functions.

Coolant Temperature/System Voltage Display

This display located in the Driver Information Center is a three digit display which can be switch selected by the driver to display coolant temperature or system voltage in English or metric units.

A telltale feature has been incorporated in this display.

Fuel Economy Display

By selecting the proper function select switch, the fuel economy display will display either instant fuel economy or average fuel economy.

Display will display range (miles to empty depending on the average fuel economy and fuel remaining) or trip distance (distance traveled since the trip odometer was reset). The display will display either English or metric by proper selection of the English/Metric switch.

When the last bar of the fuel display "goes out", the on-reverse function is implemented and the "low"

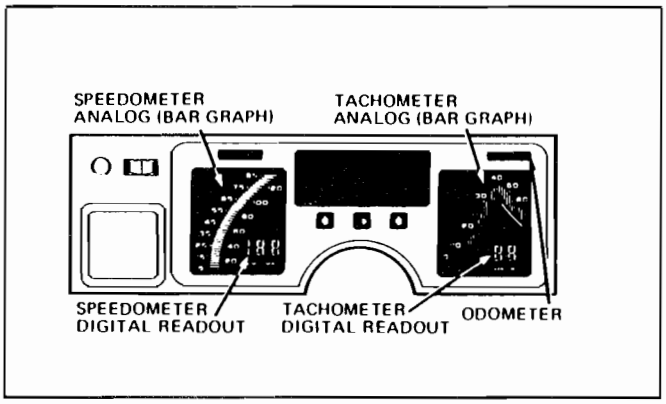


Figure 8C-2 Instrument Cluster

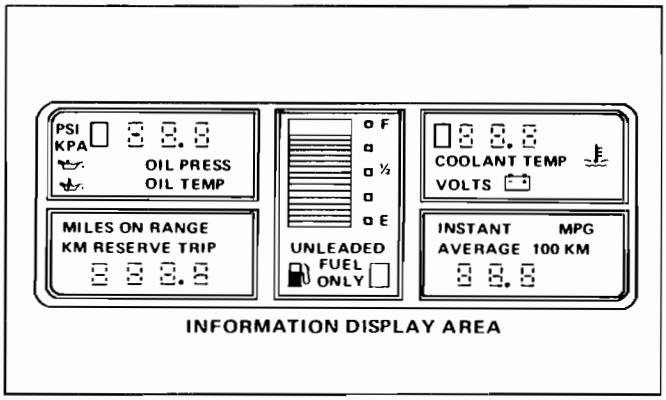


Figure 8C-3 I.P. Telltale Panel

1. Air Cond. Outlet
2. Main Light Switch
3. Fog Light Switch
4. Speedometer
5. Oil Pressure or Oil Temp Readout & Warning Indicators
6. Range and Trip Odometer Readout & Reset Button
7. Eng. Coolant Temp or Voltage Readout & Warning Indicators
8. Fuel Economy - Instantaneous or Average Readout & Reset Button
9. Fuel Gage with Low Fuel Warning
10. Hi-Beam Indicator
11. Turn Signal Indicator
12. Odometer (Total Vehicle Miles)
13. Tachometer
14. Fasten Belts
15. Brake - Low Line Pressure or Parking Brake On
16. Security
17. Check Engine
18. Low Fuel
19. Door Ajar
20. Hatch Ajar
21. Electric Rear Hatch Release (Inside Compartment)
22. Door Lock/Security Switch (One/Door)
23. W/S Wiper and Washer Switch
24. Rear Window Defogger & Heated Dual Sport Mirrors
25. Cigarette Lighter and Ash Tray
26. Power Window Switches
27. Power Sport Mirror Control
28. Glove Box Latch
29. Glove Box & Cassette Tape Stowage (Inside Compartment)
30. Power Seat Control (Opt.)

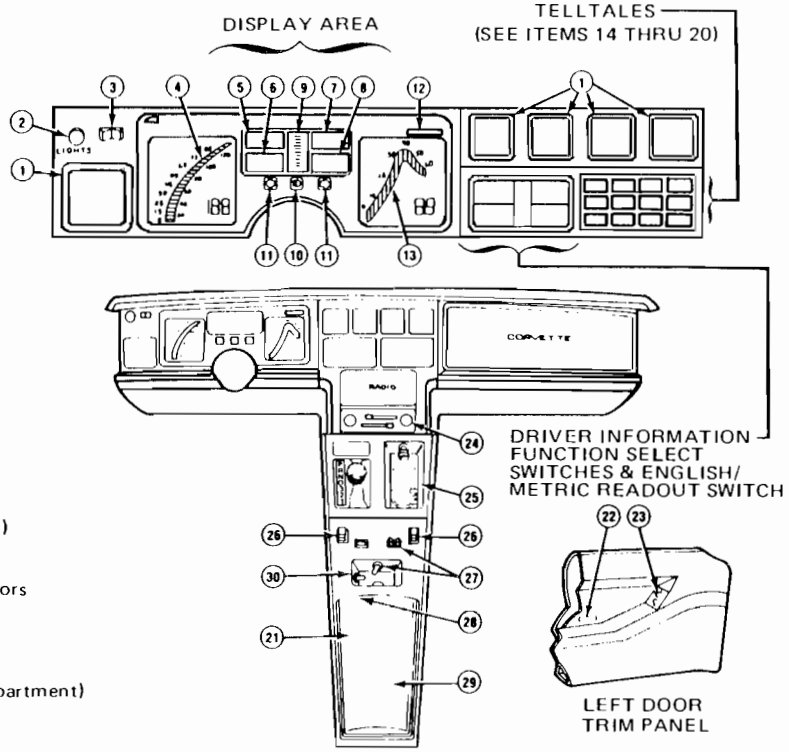


Figure 8C-1 Instrument Panel Layout

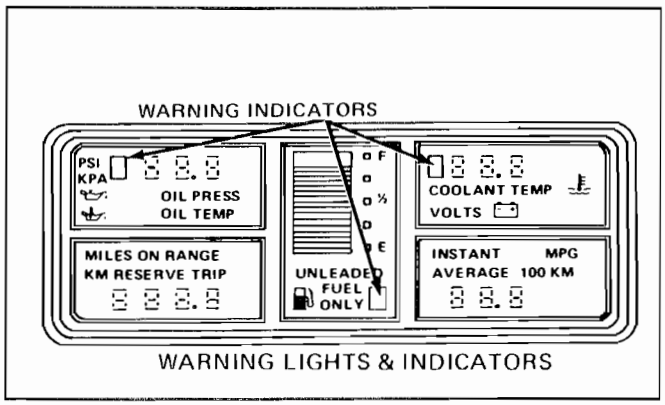


Figure 8C-4 Driver Information Center

fuel telltale is turned on. When the "on-reverse" function is implemented, the display will show "miles traveled" since the "on-reverse" feature was implemented. The "on-reverse" feature is further explained in the telltale section.

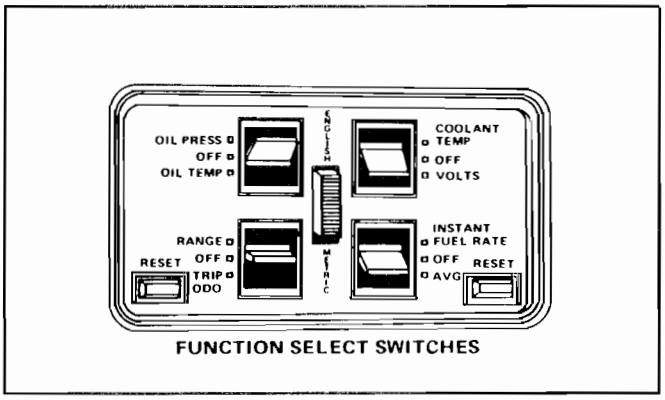


Figure 8C-5 Function Select Switch Panel

Telltales

Three telltales have been incorporated into the Driver Information Center to serve as warning signals if an "out of normal range" condition occurs on any of the following five functions:

- Oil Pressure
- Oil Temperature
- Coolant Temperature
- System Voltage
- Fuel Level

One telltale serves as "Low" fuel level warning, and the other two are shared by the oil pressure/temperature telltale and the coolant temperature/system voltage telltale.

Dimming

Instrument panel dimming depends upon both the photocell input and the dimmer rheostat setting. The photocell measures the brightness of daylight. Its contribution is added to the dimmer rheostat setting (if park lights are on) to determine the amount of dimming for the displays.

In the event a telltale light comes on, indicating an "out of normal range", maximum display brightness will occur.

Electronic Cruise Control Function

On vehicles so equipped, the cruise control system is controlled by electronic circuitry within the cluster. Information on General Description, Theory of Operation, Service and Diagnosis of this system is covered in Section 9, Accessories. Electrical wiring and circuitry are also shown in Section 8A, Electrical Diagnosis.

DIAGNOSIS

Diagnosis of the instrument cluster is covered in Section 8A (Electrical Diagnosis) of this manual.

SPECIAL SERVICE TOOLS (FIGURE 8C-47)

- J-33431 Signal Generator/Instrument Panel Tester with accompanying instructions.
- Halogen bulb removal tool-J-33885.

ON CAR SERVICE (FIGURES. 8C-7 THRU 8C-27)

Service which can be performed on the cluster is limited as outlined below.

- In car cluster diagnosis (includes harnesses).
- Removal and installation of cluster where necessary.
- I.P. illumination bulb replacement (bulbs can be removed/replaced from front of cluster).
- Illumination bulb heat sink replacement.
- Telltale panel, turn signal, hi beam lens replacement.
- Photocell lens replacement.
- Odometer replacement (where odometer does not require service but cluster is non-functional, odometer is to be removed and kept with the vehicle).

When replacing a speedometer or odometer assembly, the law requires the odometer reading of the replacement unit to be set to register the same mileage as the prior odometer. If the same mileage cannot be set, the law requires the replacement odometer be set to zero and a label be installed on the driver's door frame to show the previous odometer reading and the date of replacement.

- Liquid Crystal Display Cleaning or Contacting. Notice: To clean the glass covering the Liquid Crystal Display, wipe LIGHTLY with

a soft cloth or other non-abrasive material. If necessary, DAMPEN cloth in water or a mild non-abrasive cleaning solution. Do not apply water or cleaners directly onto the glass surface. Any excessive moisture could run down into and damage the instruments.

With the exception of the items listed above, repair service to the cluster must be performed at an authorized service center.

SERVICE PARTS

A service parts package is available for total odometer service. Replacement and/or repair is covered later in this section. Instructions are also included in the service parts package.

Replacement halogen type I.P. illumination bulbs are available from service parts.

Replacement cluster on an exchange basis with accompanying replacement instructions.

Instrument Panel Pad (Figure 8C-6)

Replacement

1. Disconnect battery ground cable.
2. Remove I.P. cluster bezel.
3. Remove steering column tilt lever.
4. Remove 5 I.P. pad to carrier screws.
5. Remove 2 screws at def ducts.
6. Remove I.P. pad.
7. Reverse above procedure to install.

Main Instrument Cluster (Figure 8C-7)

Replacement

1. Disconnect battery ground cable.
2. Remove light switch knob (spring loaded), and light switch nut.
3. Remove steering column trim cover.
4. Remove 2 steering column attaching bolts and lower steering column for access.
5. Remove cluster bezel front and left side attaching screws.
6. Remove cluster bezel from I.P.
7. Remove 4 cluster to I.P. attaching screws.
8. Pull cluster rearward for access to disconnect cluster electrical connectors. Metal retaining clips are located at back side of connectors.
9. Remove cluster from I.P. Odometer may be removed for service or replacement.
10. Reverse above procedure to install.

ODOMETER MODULE SERVICE

The parts in the odometer module service package (odometer, frame, and two brass retainer plates) are to be used to service a total odometer module. Laws governing resetting of odometers differ from one state/province to the next. Consult local requirements to determine which of the following applies:

Method A

If local requirements specify that service odometers be installed showing ZERO vehicle mileage.

1. Remove electric stepper motor from failed assembly and reinstall on new frame. Tighten both screws securely.
2. Place new odometer in new frame, making sure that gear teeth are engaged between motor and odometer, and that pinion carriers are in frame channel.
3. Place two new brass retainer plates over plastic pins on each end of frame bearings. Apply soldering iron or other heat source to reform plastic pins, holding retainers in place against frame.
4. Connect motor terminal to tester (J-3343), and check assembly for operation.

Method B

If local requirements specify that service odometers be installed showing ACTUAL vehicle mileage:

Proceed as in Method A, except between Steps 1 and 2, perform the following:

2. Remove white plastic breakable retainer from pinion carriers on new odometer. Start at left and hold pinion carriers of wheels which do not require resetting. For first wheel needing resetting, hold pinion carrier immediately to the right, then rotate next wheel clockwise. Each complete revolution will cause the wheel to the left to index by one. Continue until the correct digit registers on the first wheel to the left. Repeat this process for each wheel to the right, in turn, until odometer displays actual vehicle mileage. Reinstall breakable retainer to pinion carriers and recheck mileage after all pinion carriers have been aligned.

Right Lower I.P. Trim Pad (Figure 8C-9)

Replacement

1. Disconnect battery ground cable.
2. Remove I.P. trim pad.
3. Remove right side close out panel.
4. Remove right side I.P. trim and fuse plate.
5. Remove right flexible A/C hose and duct.
6. Remove 2 screws at carrier to side glass def. hose.
7. Remove right front trim pad.
8. Remove right lower carpeted panel.
9. Reverse above procedure to install.

RIGHT FRONT I.P. TRIM PAD (Figure 8C-11)

Replacement

1. Disconnect battery ground cable.
2. Remove I.P. cluster bezel and remove I.P. pad.
3. Remove right side close out panel.
4. Remove right side I.P. trim and fuse panel plate.
5. Remove right flexible A/C hose and duct.
6. Remove 2 screws at carrier to side glass defroster hose.

7. Remove right front trim pad.
8. Reverse above procedure to install.

I.P. Console Trim Plate (Figure 8C-12)

Replacement

1. Disconnect battery ground cable.
2. Remove 2 screws at lower portion of I.P. bezel.
3. Remove shift knob.
4. Remove console plate attaching screws and disconnect bulb connectors.
5. Remove console plate.
6. Reverse above procedure to install.

Instrument Panel Carrier (Figure 8C-13)

Replacement

1. Disconnect battery ground cable.
2. Remove I.P. cluster bezel.
3. Remove 5 Screws attaching I.P. pad to carrier.
4. Remove 2 screws at defroster ducts.
5. Remove I.P. pad.
6. Remove 4 left close out panel attaching screws. Disconnect electrical connector at courtesy lamp and remove panel.
7. Remove 4 right close out panel attaching screws. Disconnect electrical connector at courtesy lamp and remove panel.
8. Remove right side I.P. trim and fuse cover.
9. Remove 4 upper dash brace attaching screws and remove braces.
10. Remove right flexible A/C duct hose and A/C duct.
11. Remove 2 screws at I.P. to side glass defroster hose.
12. Remove right side trim pad.
13. Remove right lower carpeted panel (1 screw, 4 nuts to trim, 2 screws to O.L.)
14. Remove radio.
15. Remove 4 screws to center cluster and carrier.
16. Disconnect wire connectors at main cluster. Metal retaining clips are located at back side of connectors.
17. Remove center cluster.
18. Remove main cluster (4) screws.
19. Remove console bezel and shift handle. Disconnect bulb connector.
20. Remove 4 A/C control back through opening.
21. Remove headlamp switch attaching nut.
22. Remove fog lamp switch.
23. Remove trim piece at hood release handle.
24. Remove steering column trim cover and 2 steering column attaching bolts.
25. Remove 2 carrier to console bolts. Remove 2 nuts at upper sides of console and 2 bolts at lower sides. Disconnect fuse block from carrier.
26. Remove center A/C duct.
27. Remove left side A/C duct and 2 screws at carrier to def. duct.
28. Remove I.O. harness to carrier screws at backside of carrier and to left def. hose at column brace.

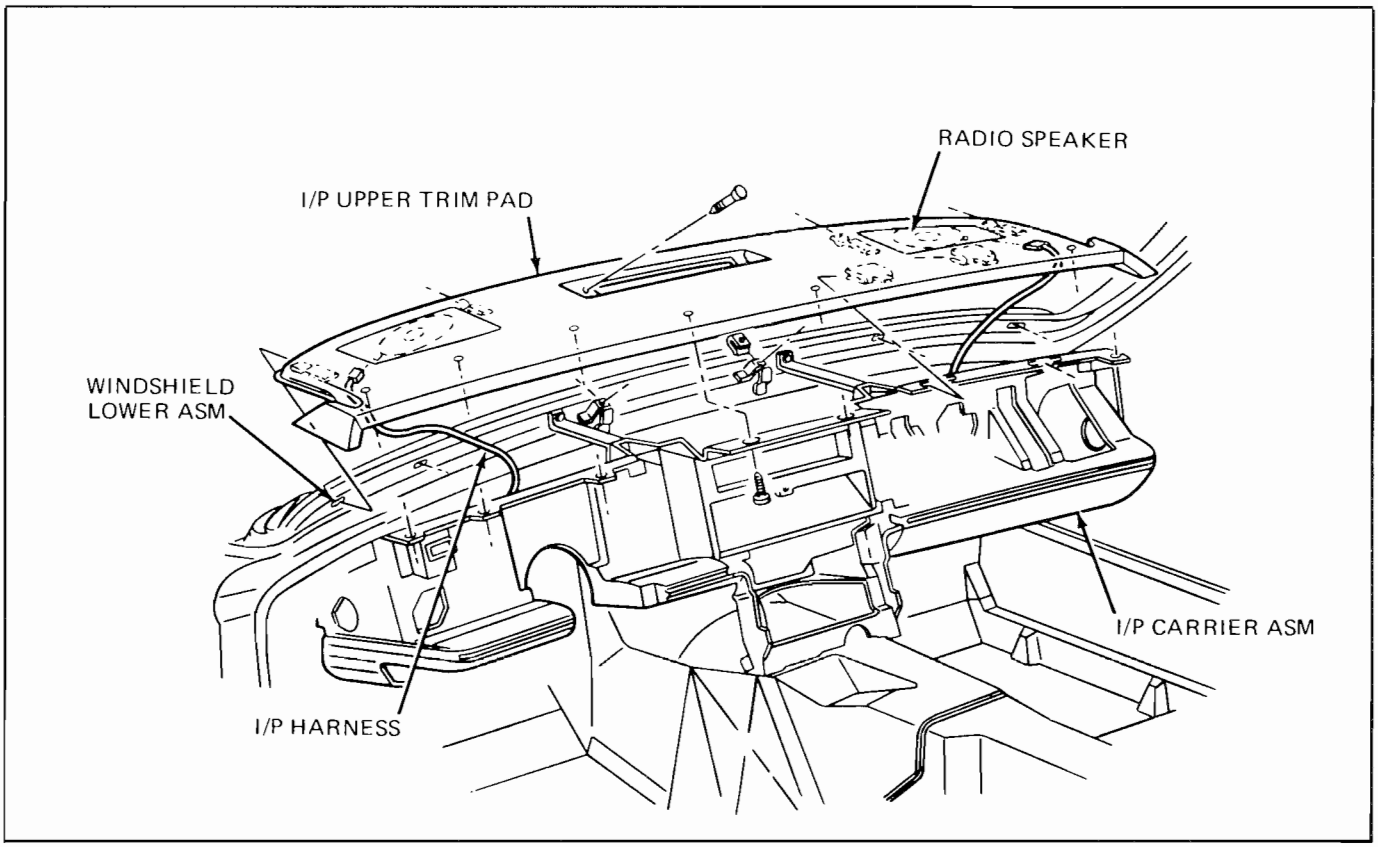


Figure 8C-9 Upper Trim Pad Assembly

29. Remove carrier.

30. Reverse above procedure to install.

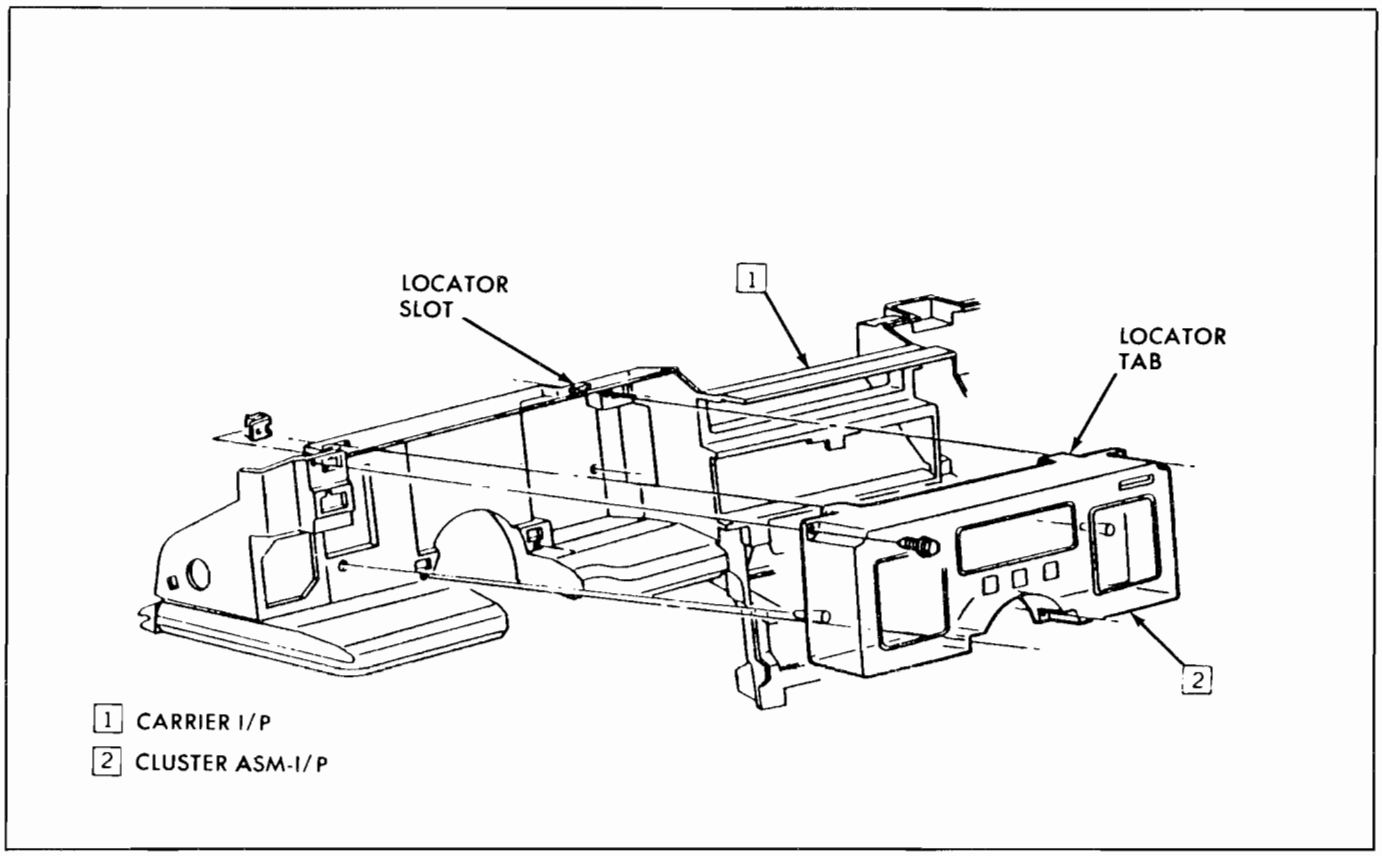


Figure 8C-7 Instrument Cluster Installation

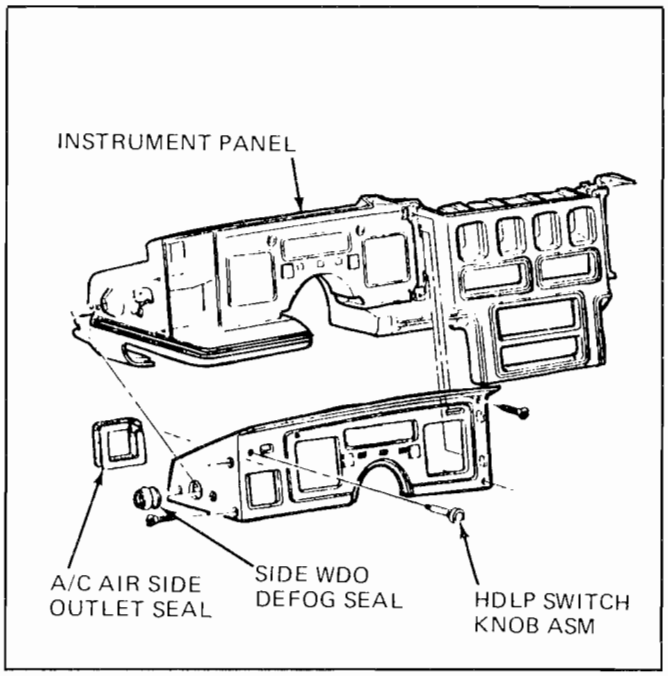


Figure 8C-8 I.P. Cluster Bezel

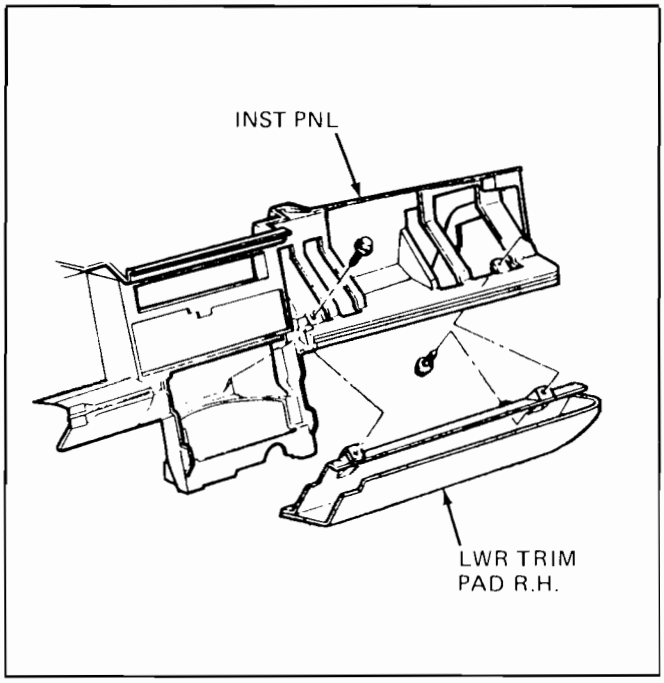


Figure 8C-9 I.P. Lower Trim Pad R.H.

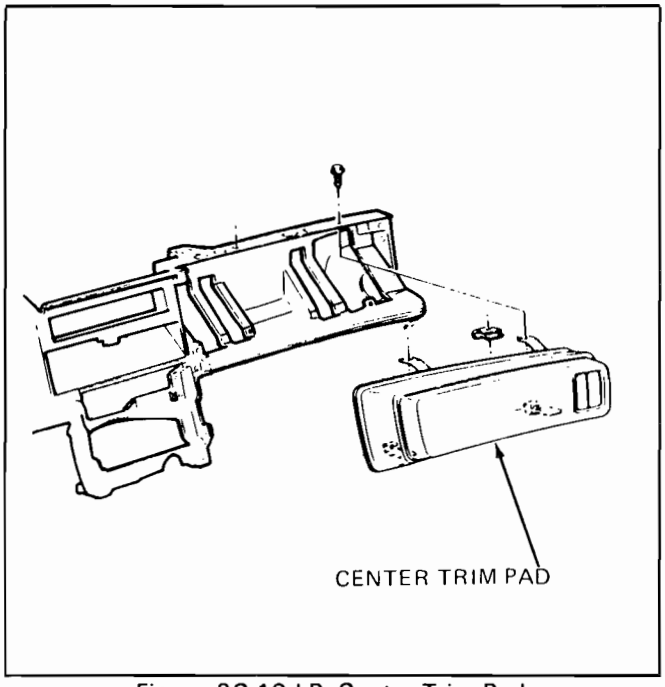


Figure 8C-10 I.P. Center Trim Pad

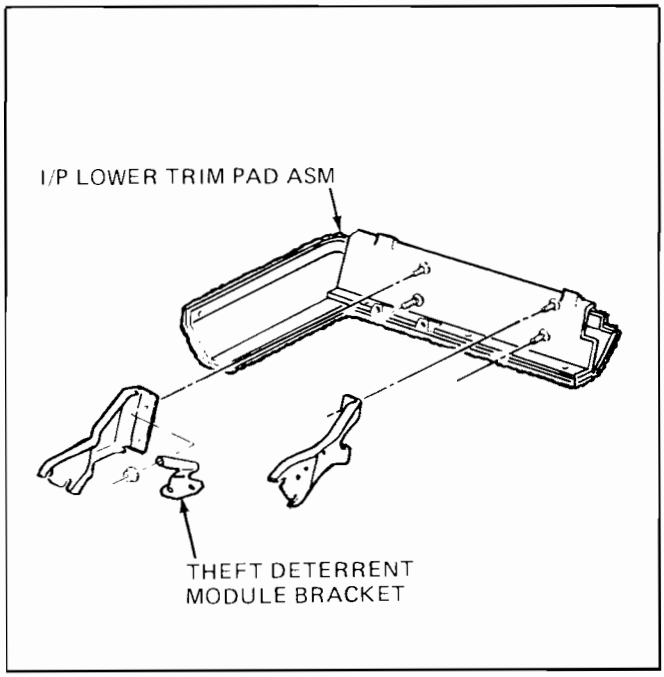


Figure 8C-11 I.P. Trim Pad R.H.

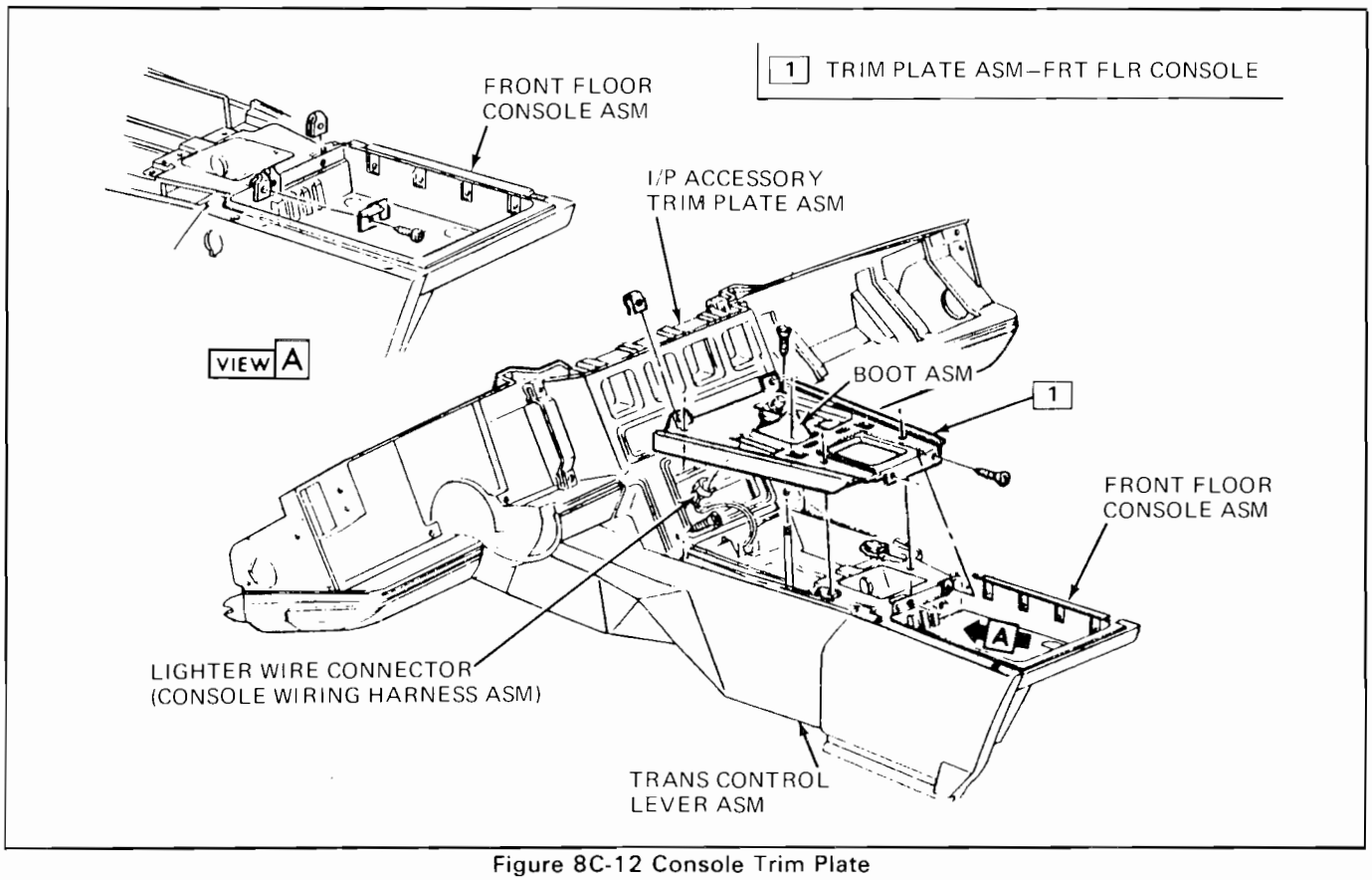


Figure 8C-12 Console Trim Plate

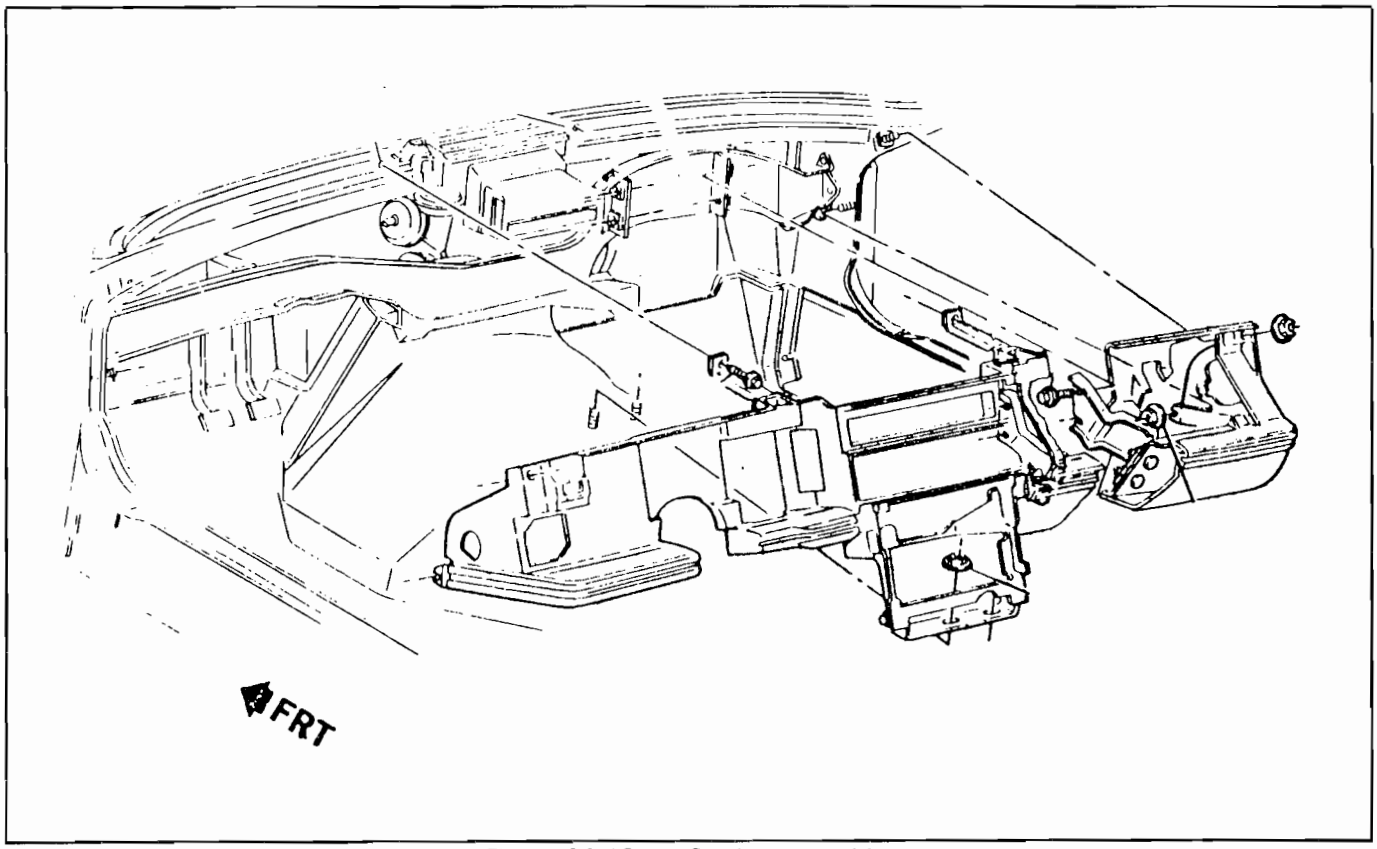


Figure 8C-13 I.P. Carrier Assembly

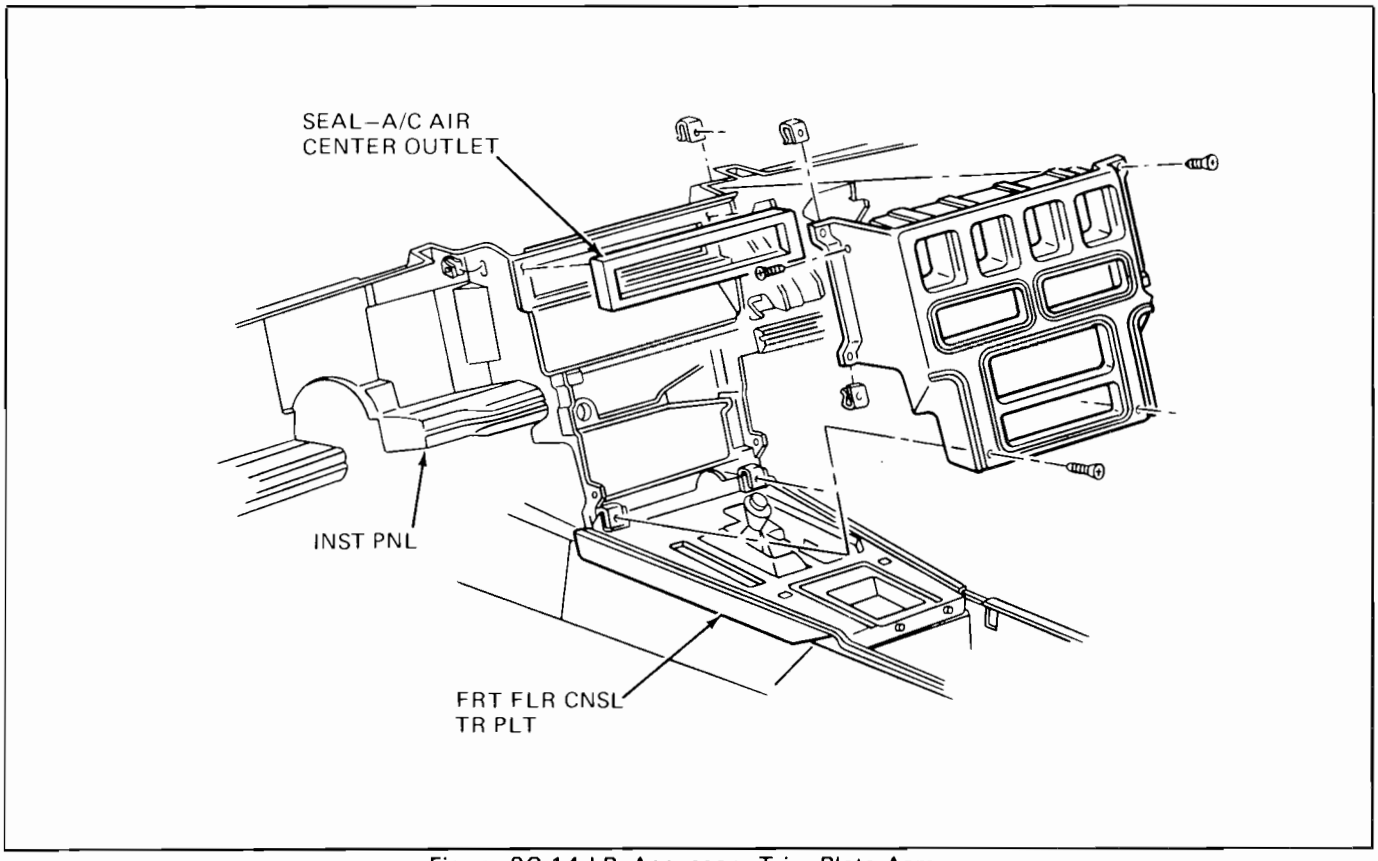


Figure 8C-14 I.P. Accessory Trim Plate Asm.

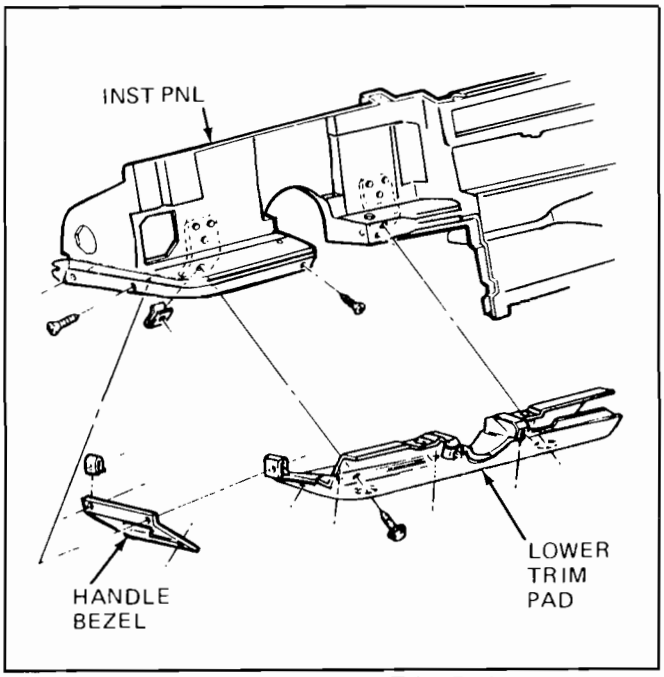


Figure 8C-15 I.P. Lower Trim Pad L.H.

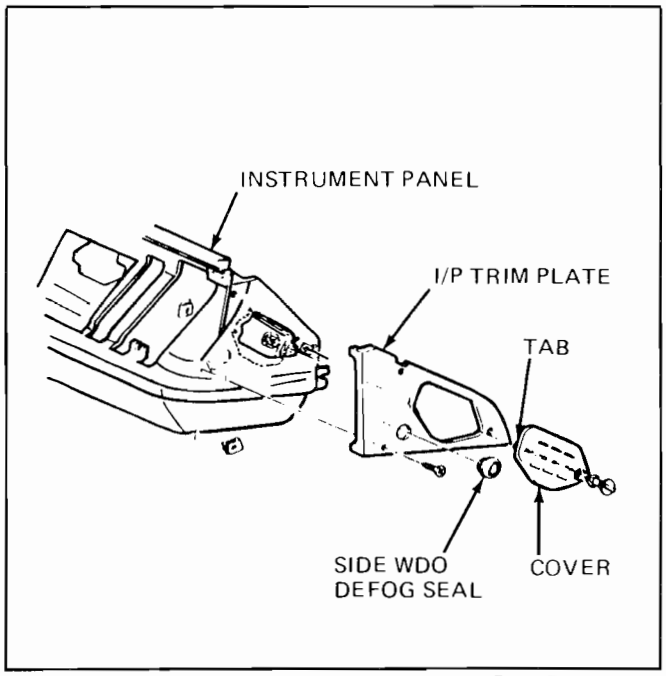


Figure 8C-16 I.P. Trim Plate and Fuse Box Cover

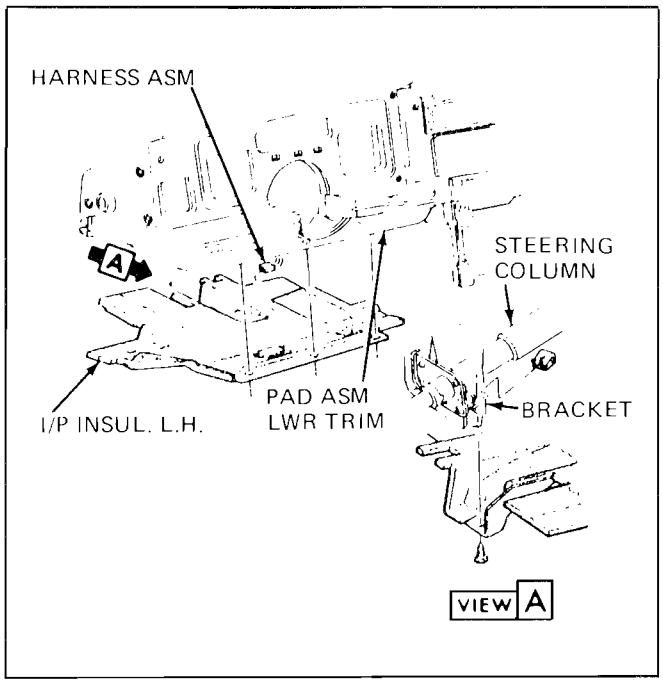


Figure 8C-17 I.P. Insulator L.H.

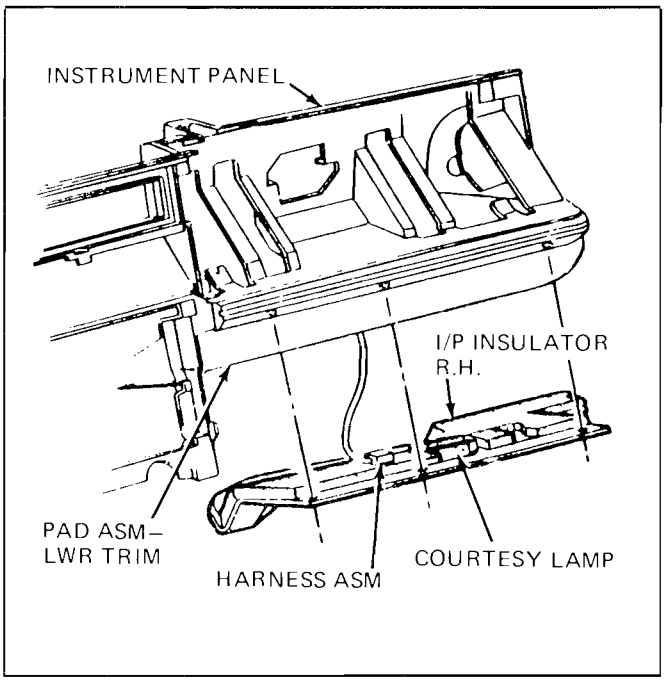


Figure 8C-18 I.P. Insulator R.H.

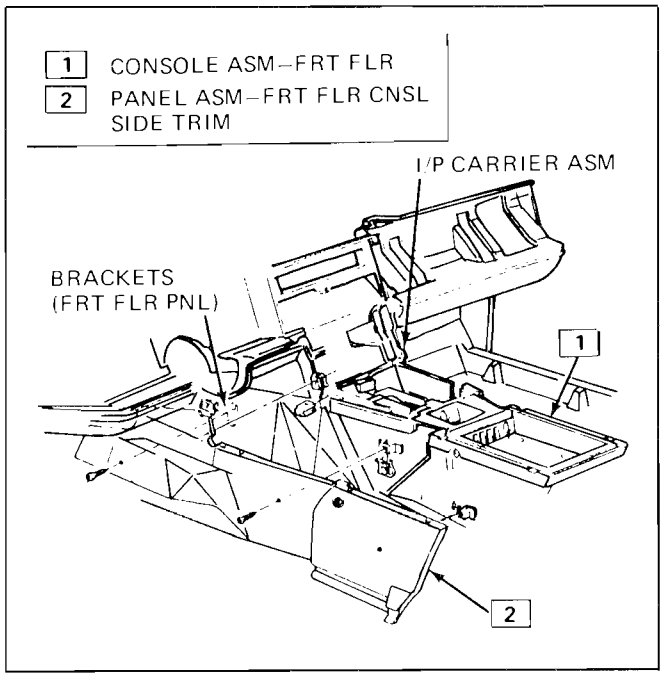


Figure 8C-19 Front Floor Console Side Trim Panel

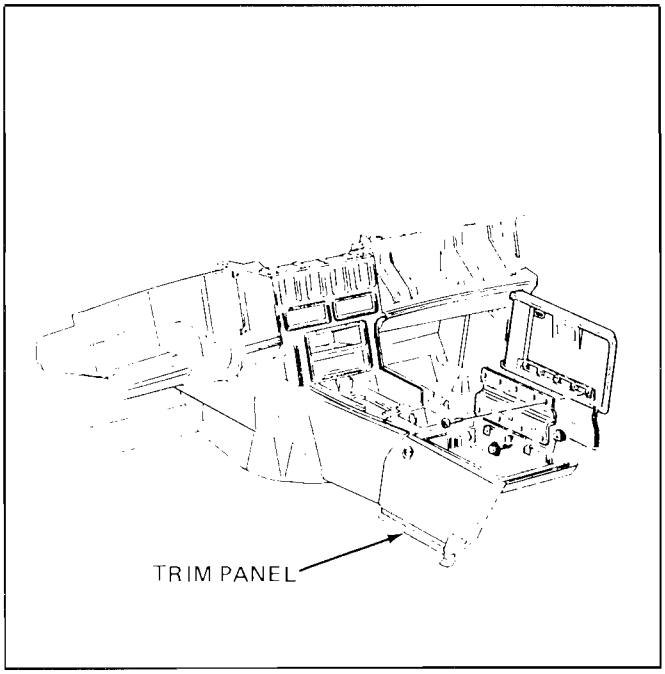


Figure 8C-20 Console Door and Hinge

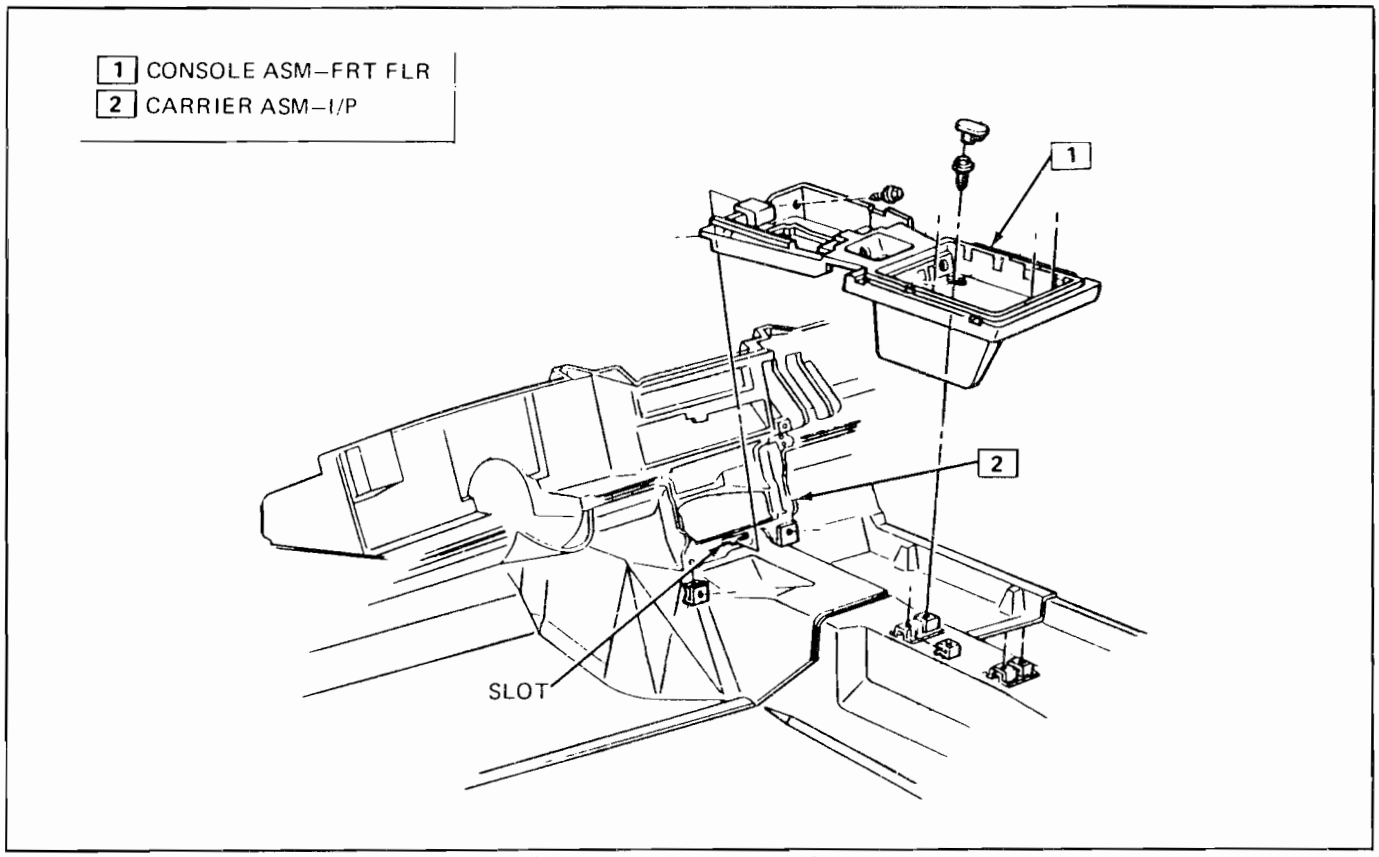


Figure 8C-21 Front Floor Console Compartment

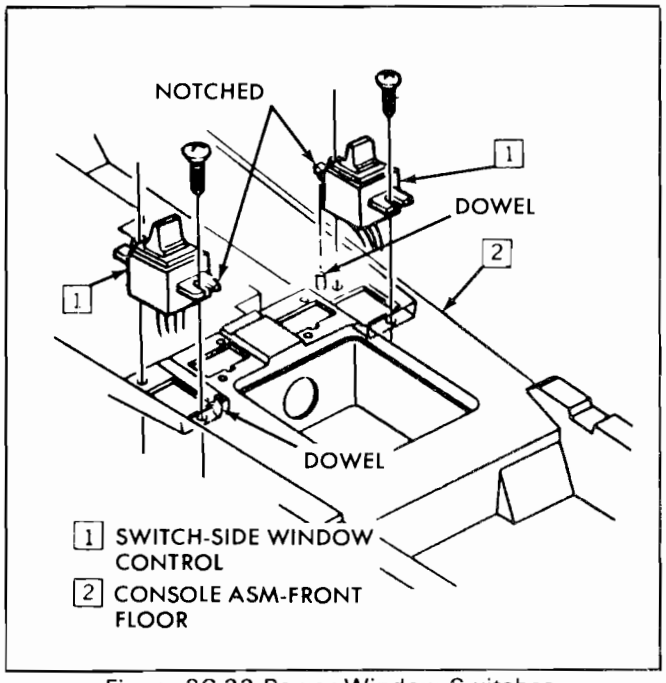


Figure 8C-22 Power Window Switches

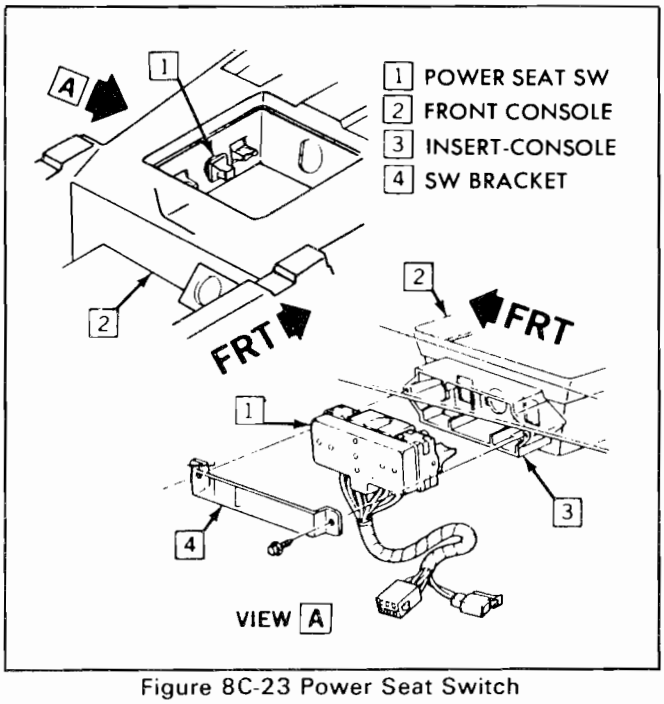


Figure 8C-23 Power Seat Switch

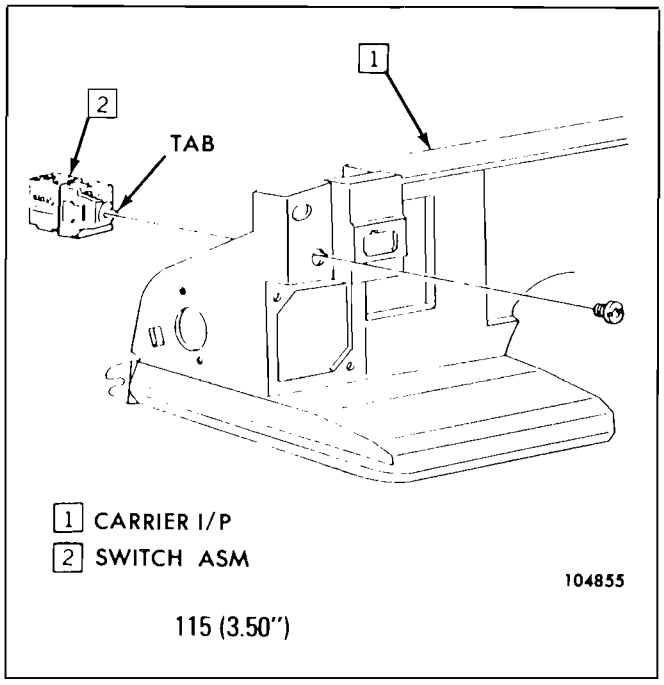


Figure 8C-24 Headlamp Switch

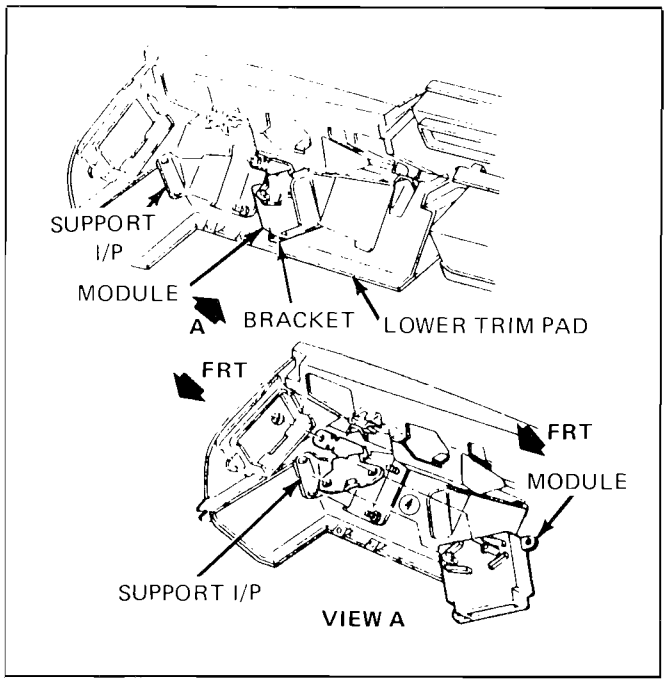


Figure 8C-25 Theft Deterrent Module

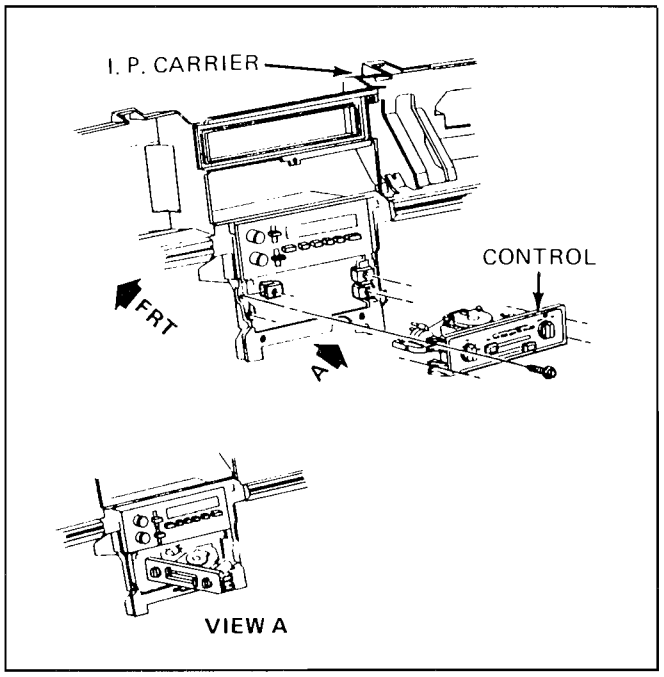


Figure 8C-26 Control Mounting

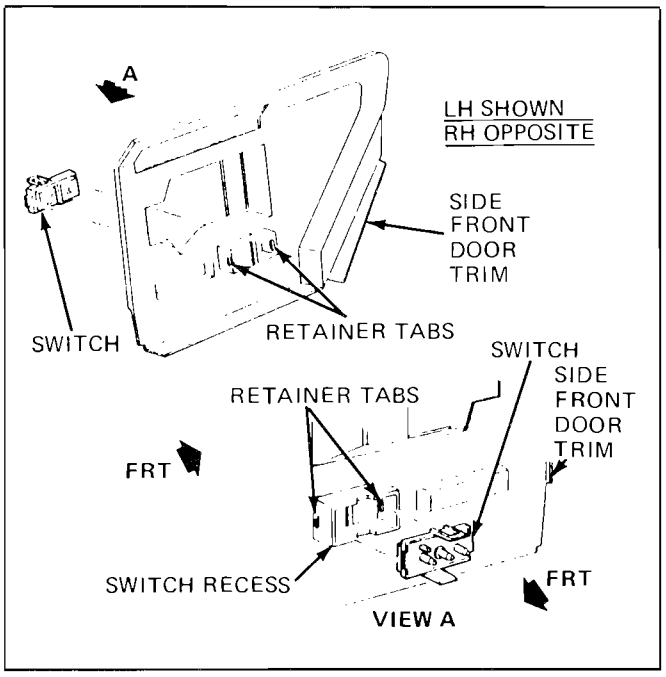


Figure 8C-27 Door Lock Switch

THEFT DETERRENT SYSTEM-UTD/VATS

GENERAL DESCRIPTION

The Vehicle Anti-Theft System (VATS) works with the present theft deterrent system (UTD). The UTD system remains the same, except it no longer controls engine cranking.

The system operates to perform two functions, and controlled by the UTD and VATS modules.

The UTD module controls the operation of the alarm portion of the system. Figure 8C-28 illustrates the areas monitored by the two modules.

Alarm Description

The system alarm pulsates the vehicle's horns at a rate of 50 cycles per minute. At the same time the alarm is triggered, the starter interrupt relay is energized which disables the starter solenoid circuit.

In order to conserve vehicle battery power, the alarm shuts off after three to seven minutes of operation and rearms. However, once triggered, the starter interrupt relay will remain energized by the

controller until the system has been properly disarmed.

Protective Switches

The doors and rear hatch are equipped with protective switches which will trigger the alarm, if opened while the system is in the armed condition. The switches are located in both door hinge pillars and at the hatch opening.

Each door lock is equipped with a tamper switch which will trigger the alarm if the lock cylinder is tampered with in any way different from the normal mode of operation.

System Fusing

The Electronic Theft Deterrent System (UTD) is electrically protected by a 10 amp fuse.

Controller

The controller is all electronic and is serviced on an exchange basis. The controller operates in two stages; first is the "Armed" stage, and the second is the "Activated" stage. These stages will be explained separately.

Arming

After the ignition is turned off, the system may be armed at either opened door by:

1. With power door locks: Activating the electric door lock switch to the lock position.
2. With manual door locks: Depressing the door lock button to the lock position. When the last door is closed, (after a 5 second delay) the system arms.

Disarming

The system is disarmed by unlocking the driver's door with the key or by turning the ignition on. Alarm shut down is accomplished only by unlocking the door with the key.

If the driver wants to prevent arming the system after using the "Door Lock" rocker switch, the switch can be moved to the unlock position before closing all doors. He may also cancel the arming process by rotating the ignition switch to the "ON" position, then back to lock. Rotating the ignition switch will not cancel the alarm once it is activated.

The doors may be locked mechanically using the door key without arming the system. The ignition key in the ignition lock can only disarm the system, (before the alarm is activated).

Automatic Shut Down

Once the alarm has been activated, alarm will continue to operate for a period of three-seven minutes. At the end of the time out period, the alarm will automatically shut off to conserve battery power and, if the locks have not been damaged, the system will rearm itself. However, once the system has been activated, the starter interrupt relay will remain energized until the proper disarming sequence is initiated.

VATS SYSTEM

VATS uses a special ignition key which allows the VATS module to:

1. Signal the ECM.
2. Close the starter circuit.

Without a signal response from the VATS module, the ECM will not allow fuel injection.

VATS protection is present even after the present alarm system is defeated, or if the car is left unlocked.

Use of the VATS system requires no changes in operation (arm-disarm) over the 1985 system.

VATS SYSTEM OPERATION

The VATS system operates to prevent starting (cranking) of the vehicle, and fuel delivery to the engine, using any key other than the special electrically coded ignition keys supplied with the vehicle at new car delivery.

The VATS system operates independently of the present UTD alarm system.

The system is completely passive and requires no active involvement from the operator to function.

When the operator turns the ignition "OFF", cranking and engine fuel delivery are automatically disabled.

Inserting the properly encoded key into the ignition, signals the VATS module to permit cranking and fuel delivery to the engine.

If the key used does not have the proper electrical coding (unauthoized starting), the VATS module will reset for 2 to 4 minutes (crank and fuel disabled) and will not permit starting during this period even with the proper key.

To start the vehicle, the key must have the correct mechanical and electrical coding.

The ignition lock cylinder contains electrical contacts used to "read" the ignition key.

KEY REPLACEMENT

If the ignition key is lost and the mechanical code is unknown, the mechanical code must be determined using current key replacement procedures.

The mechanical code must be cut on a blank designed for use with the VATS system. The key must be electrically coded to match the code of that particular VATS equipped vehicle. Electrical coding requires two steps. A special decoding tool is used to determine the code required, the proper code is then programmed into the key.

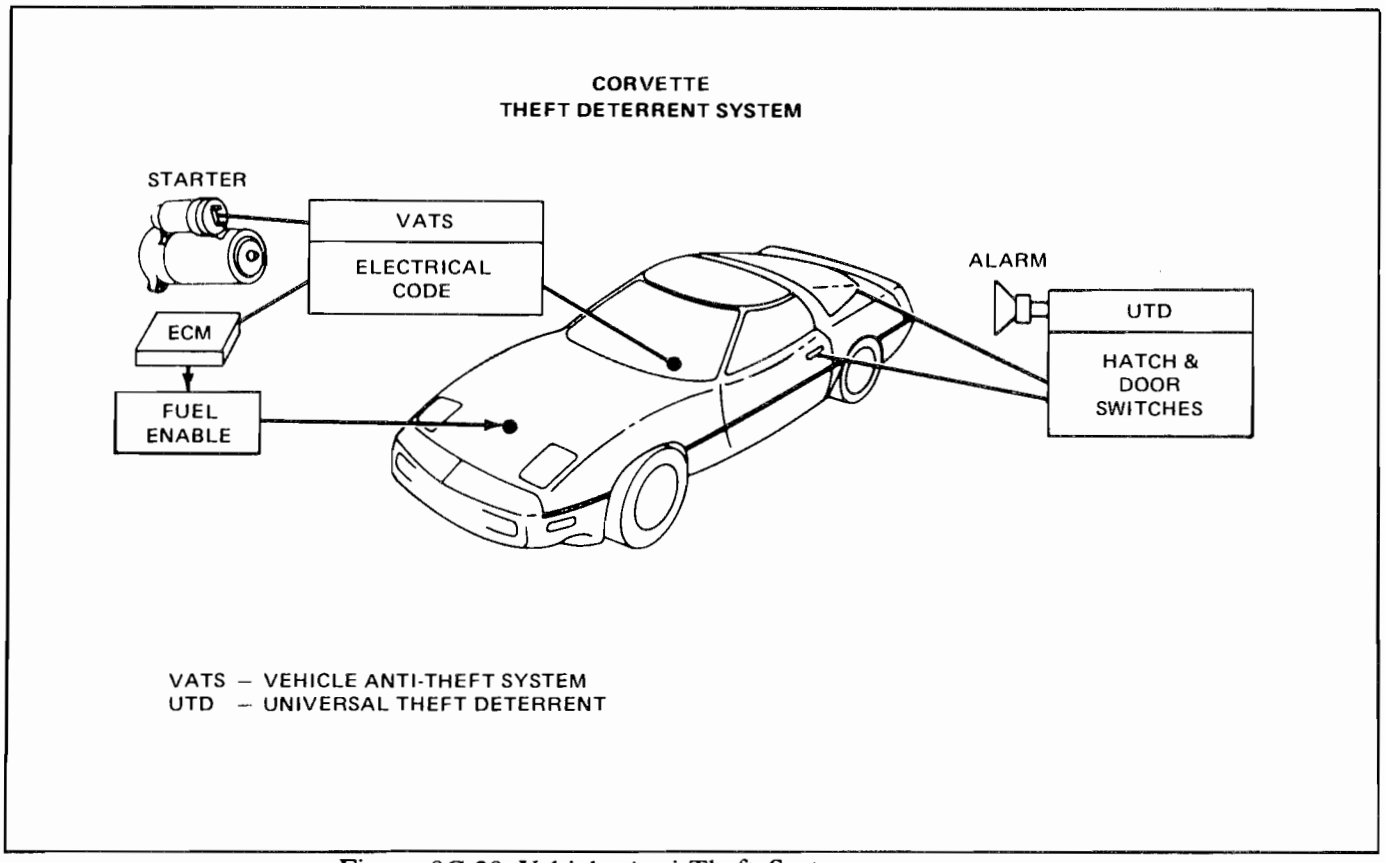


Figure 8C-28 Vehicle Anti-Theft System

DIAGNOSIS

Electrical Diagnosis of the Anti-Theft System is covered in Section 8A-Electrical Diagnosis. Engine starting (no crank, no fuel) are also covered in Section 6D and 6E respectively.

ON CAR SERVICE

COMPONENT LOCATIONS (FIGS. 8C-31 AND 8C-32)

Start Enable Relay (Figure 8C-29)

The start enable relay is located in the multi use relay center behind the I.P. switch panel.

VATS Module (Figure 8C-30)

The VATS module is located behind the dash.

KEY REPLACEMENT

Procedures for mechanical coding of ignition keys is covered in Section 10.

IGNITION SWITCH

Ignition switch replacement is covered in Section 3B-Steering.

Component Locations - UTD Portion

Figures 8C-31 and 8C-32 illustrate the location and mounting of hood, and door switches, horns (existing vehicle horn system) and door anti-tamper switch.

The oval head (glove box & spare tire) key, when inserted into the door lock cylinder and turned counterclockwise 90 degrees, will turn off the alarm. Plungers located in both door jambs and under the right side of the hood will trigger the alarm if the hood or doors are opened, completing the ground circuit to cause the warning horn to sound.

The only way to shut the alarm off is to insert the oval head key into the door lock cylinder and turn the key 90 degrees, counterclockwise.

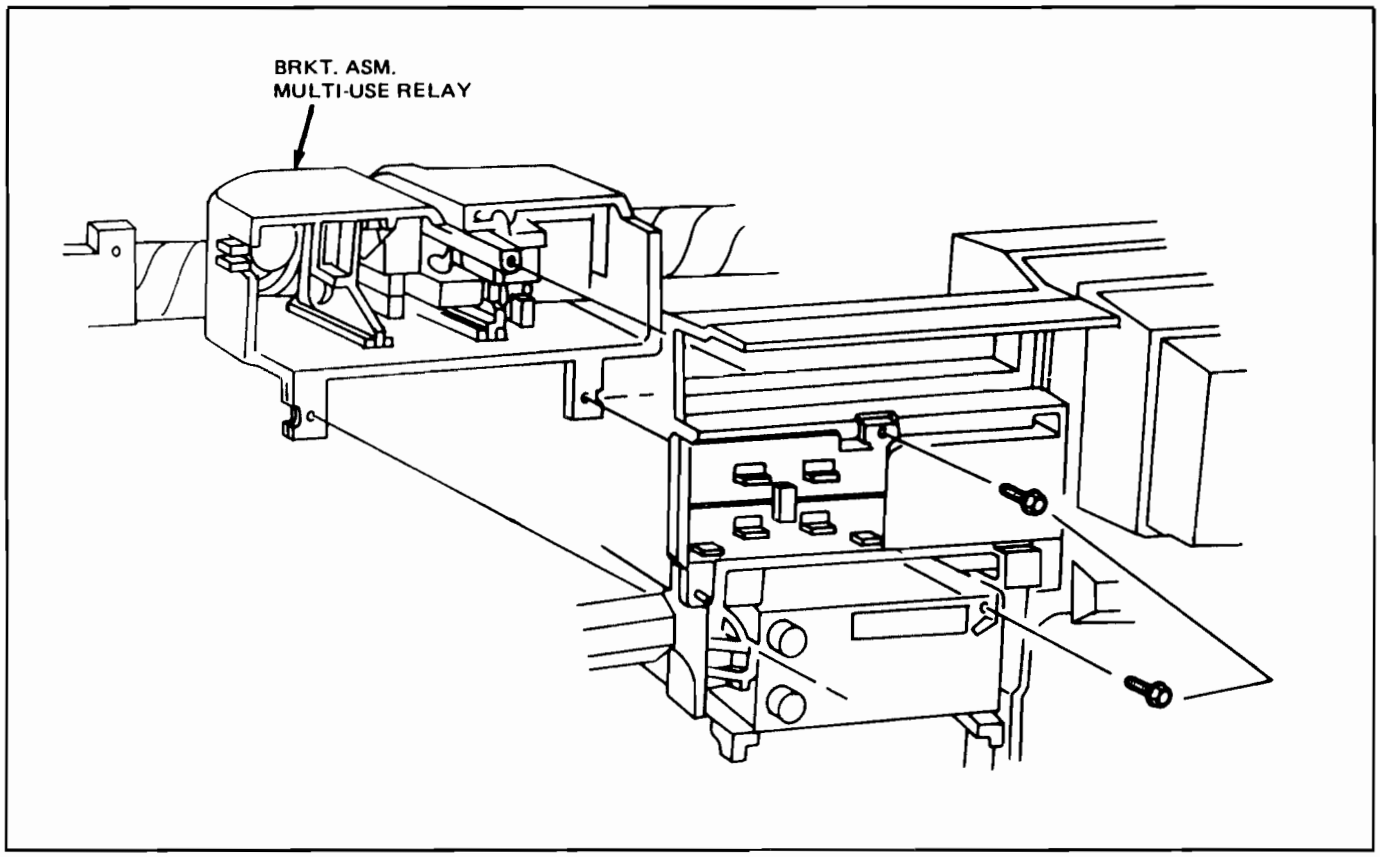


Figure 8C-29 Start Enable Relay Location

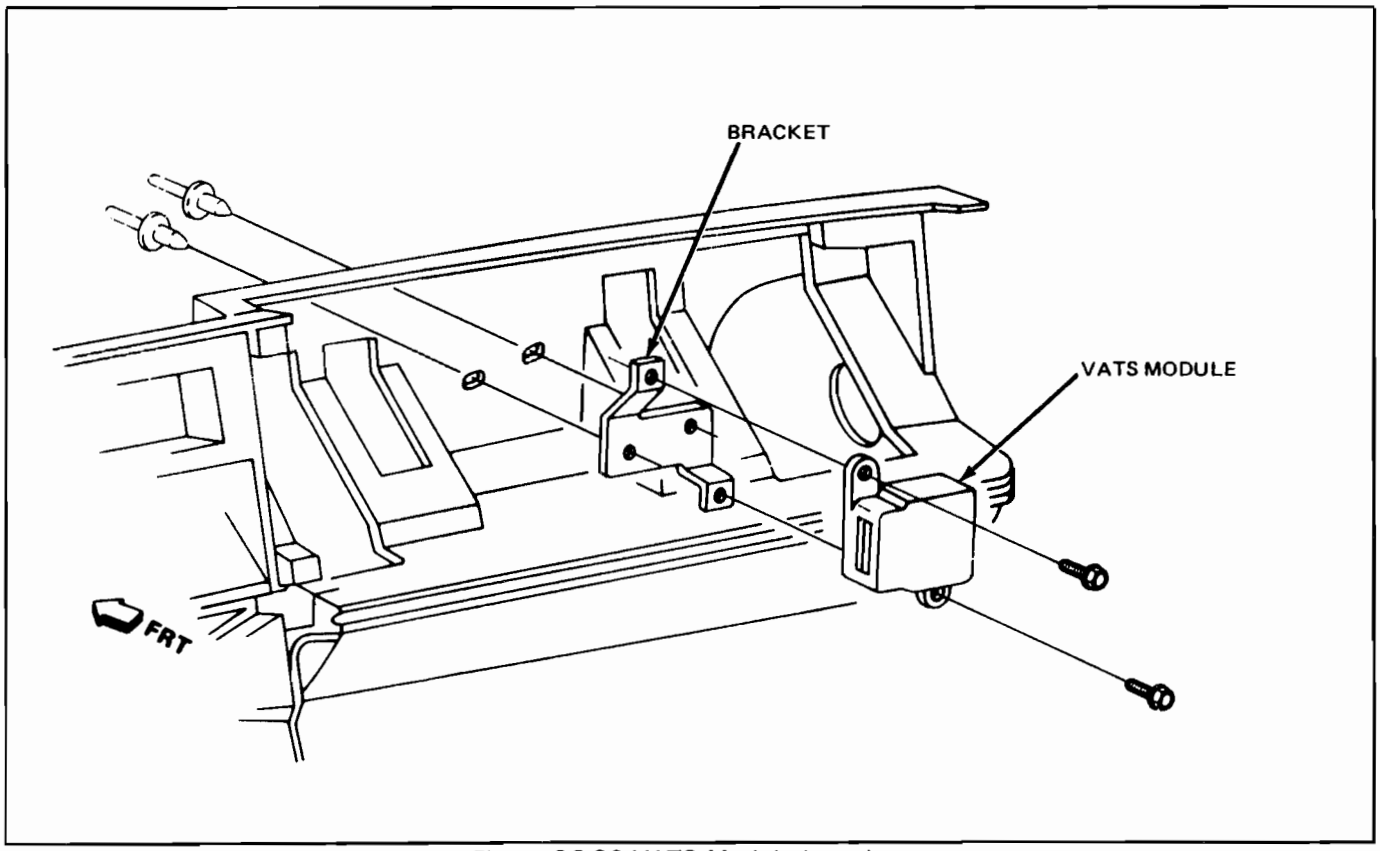


Figure 8C-30 VATS Module Location

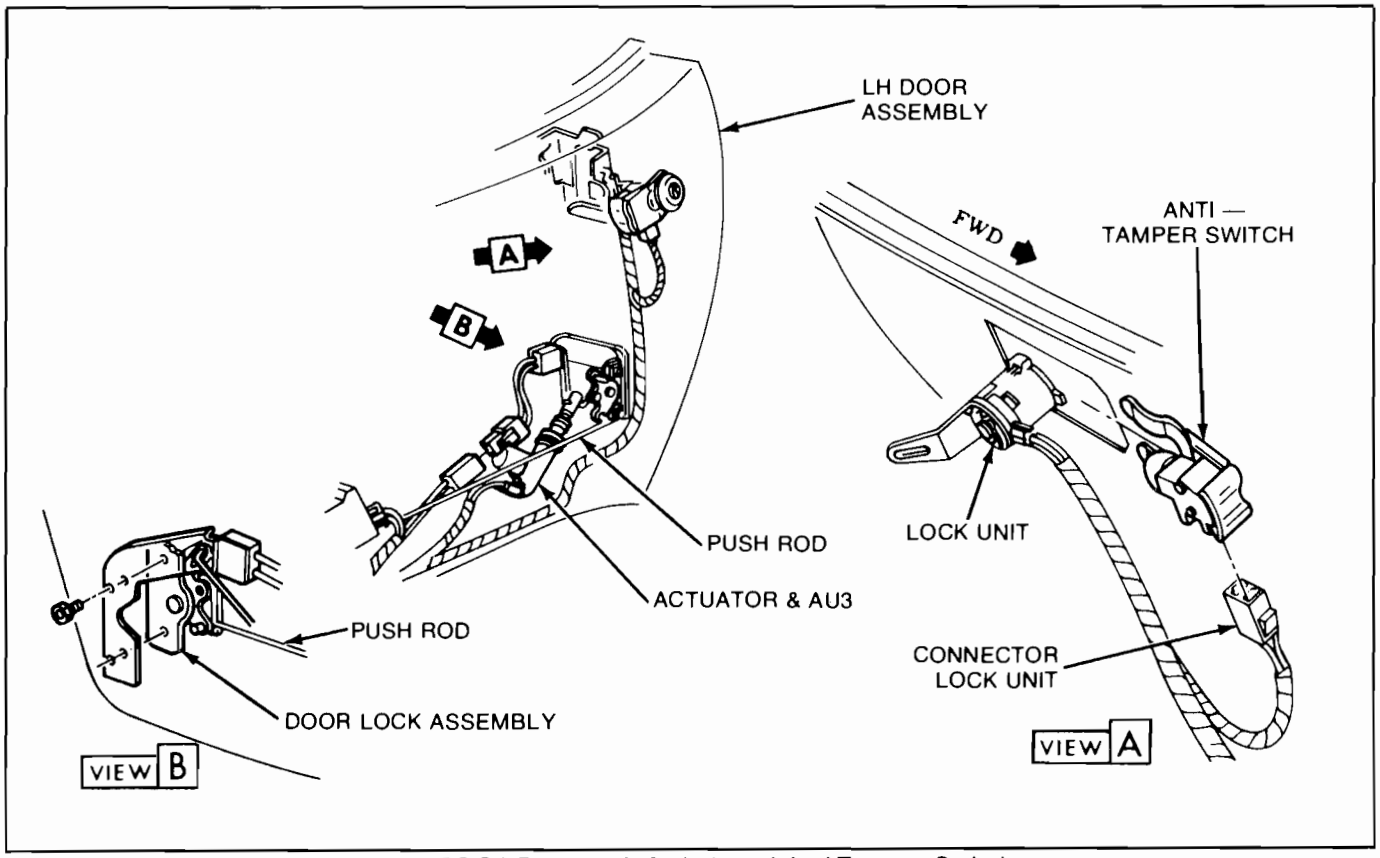


Figure 8C-31 Door Lock Switch and Anti-Tamper Switch

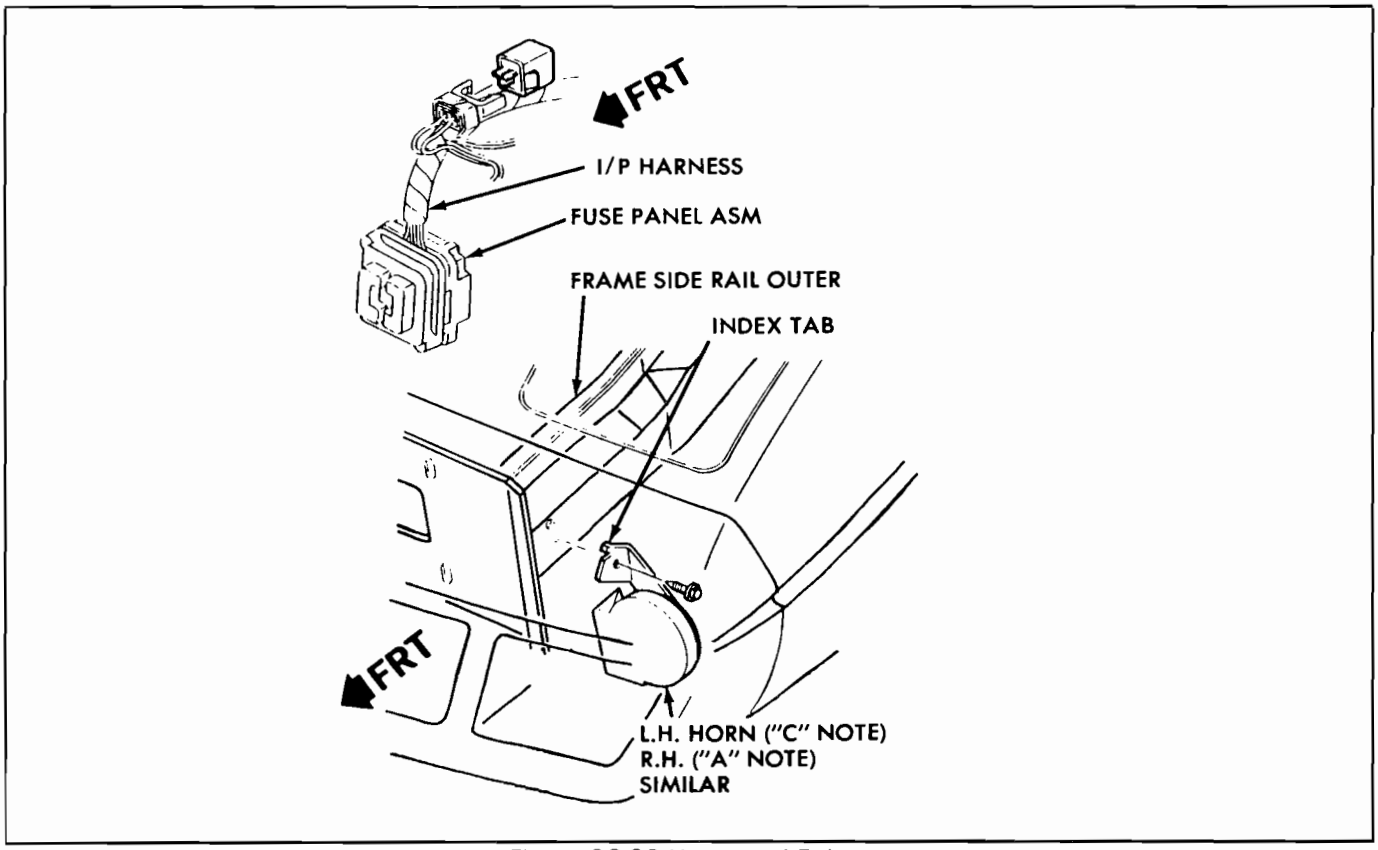


Figure 8C-32 Horns and Relay

SECTION 8E

WINDSHIELD WIPER SYSTEM

CONTENTS

Windshield Wiper/Washer 8E-1
General Description 8E-1
Operation 8E-1
Diagnosis 8E-3
On Car Service 8E-5

GENERAL DESCRIPTION

The Corvette pulse windshield wiper and washer system consists of a new permanent magnet depressed park pulse wiper (Figure 8E-1), a washer pump mounted under the washer bottle and a wiper switch mounted in the driver side door.

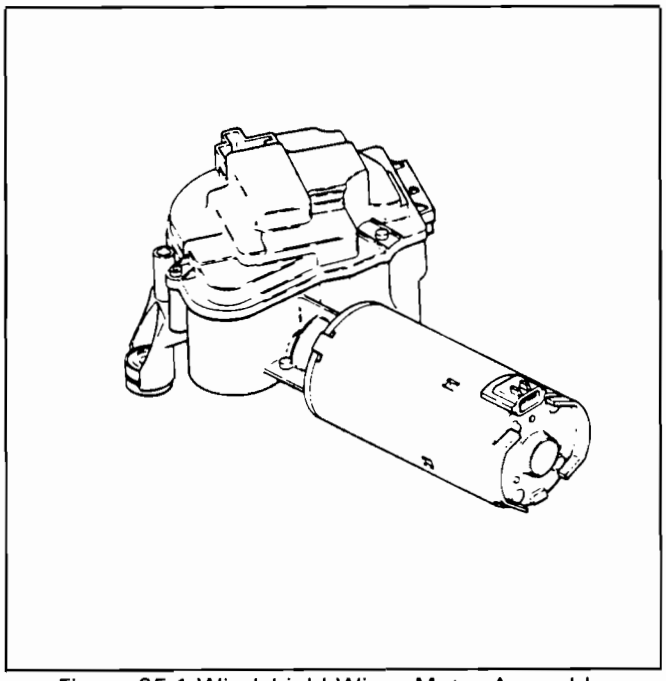


Figure 8E-1 Windshield Wiper Motor Assembly

The pulse and timing functions, along with the program and demand wash functions, are controlled by a printed circuit board permanently attached to the wiper cover.

A circuit diagram of the wiper is shown in Figure 8E-2.

WIPER AND WASHER OPERATION

The wiper and washer operation can easily be explained by the chart which follows.

The electronic circuit (P.C.) board controls all the timing and washer commands. It is to be noted on the function chart that two types of washer functions are available. When the washbutton is pushed for **less than one second, a programmed** type wash is performed which is approximately 2-1/2 seconds of fluid flow followed by approximately 6 seconds of dry wipes and a shut off. When the wash button is pushed for **more than one second, a demand** type wash is performed for as long as the button is held, followed by approximately 6 seconds of dry wipes and a shut off.

Moving the switch to the "Lo" or "Hi" speed position completes the respective brush circuit to 12V(+) at the switch and the wiper motor runs at that speed.

Moving the switch to the "Pulse" mode operates the motor intermittently and the delay can be caried by moving the switch back and forth in the delay mode.

An instantaneous wipe can be obtained by moving the switch to the "Mist" position and a continuous wipe will be performed if the button is held.

WIPER SWITCH POSITION		WASH BUTTON POSITION		
		OFF	BUTTON HELD LESS THAN ONE SECOND	BUTTON HELD MORE THAN ONE SECOND
	OFF	Wiper and washer are off — blades are at park position.	Wiper starts, runs and washes in low speed. Fluid flows approx. 2½ seconds, followed by approx. six seconds of drying wipes. Wiper then returns to park and shuts off.	Wiper starts, runs and washes in low speed. Fluid flows as long as button is held, then approx. six seconds of drying wipes and wiper returns to park position and shuts off.
	DELAY	Wiper runs one low speed wipe. Blades stop at inner wipe position, next wipe is delayed for period of time of 0-25 seconds (depending upon rheostat setting), then cycle repeats.	Delay function is overridden and followed by wash and dry cycle above. Blades then return to innerwipe position and delay function resumes.	Delay function is overridden and followed by wash and dry cycle above. Blades then return to innerwipe position and delay function resumes.
	LOW	Wiper runs in continuous low speed.	Wiper continues to run in low during wash cycle above, and remains in low speed after wash.	Wiper continues to run in low during wash cycle above, and remains in low speed after wash.
	HIGH	Wiper runs in continuous high speed.	Same as low speed wash above except motor running in high speed.	Same as low speed wash above except motor running in high speed.

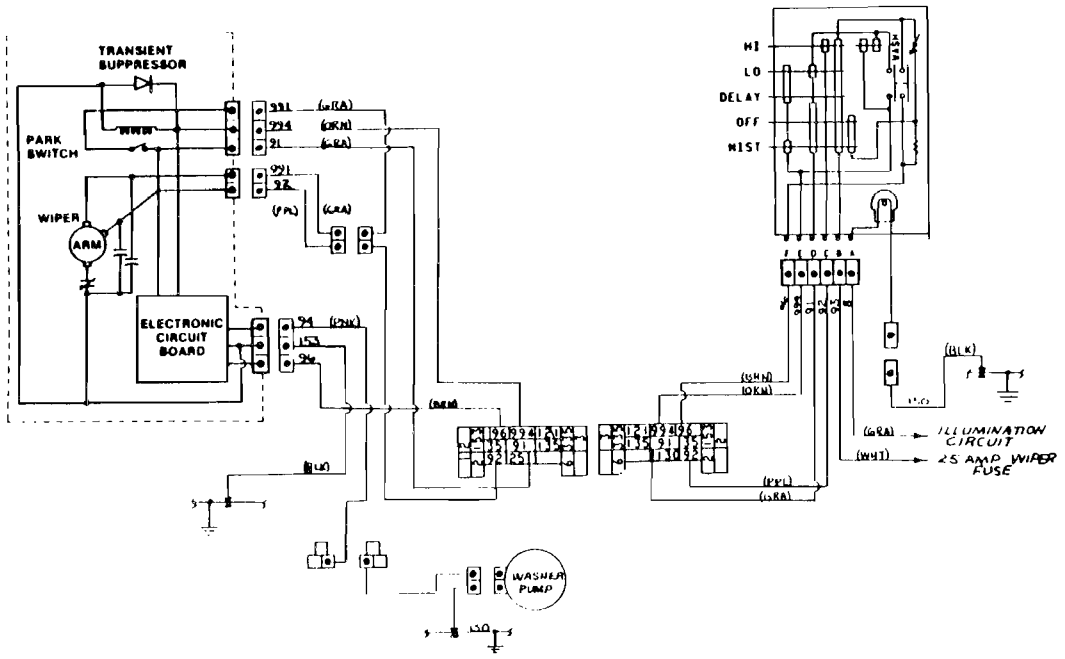


Figure 8E-2 Wiper Circuit Diagram

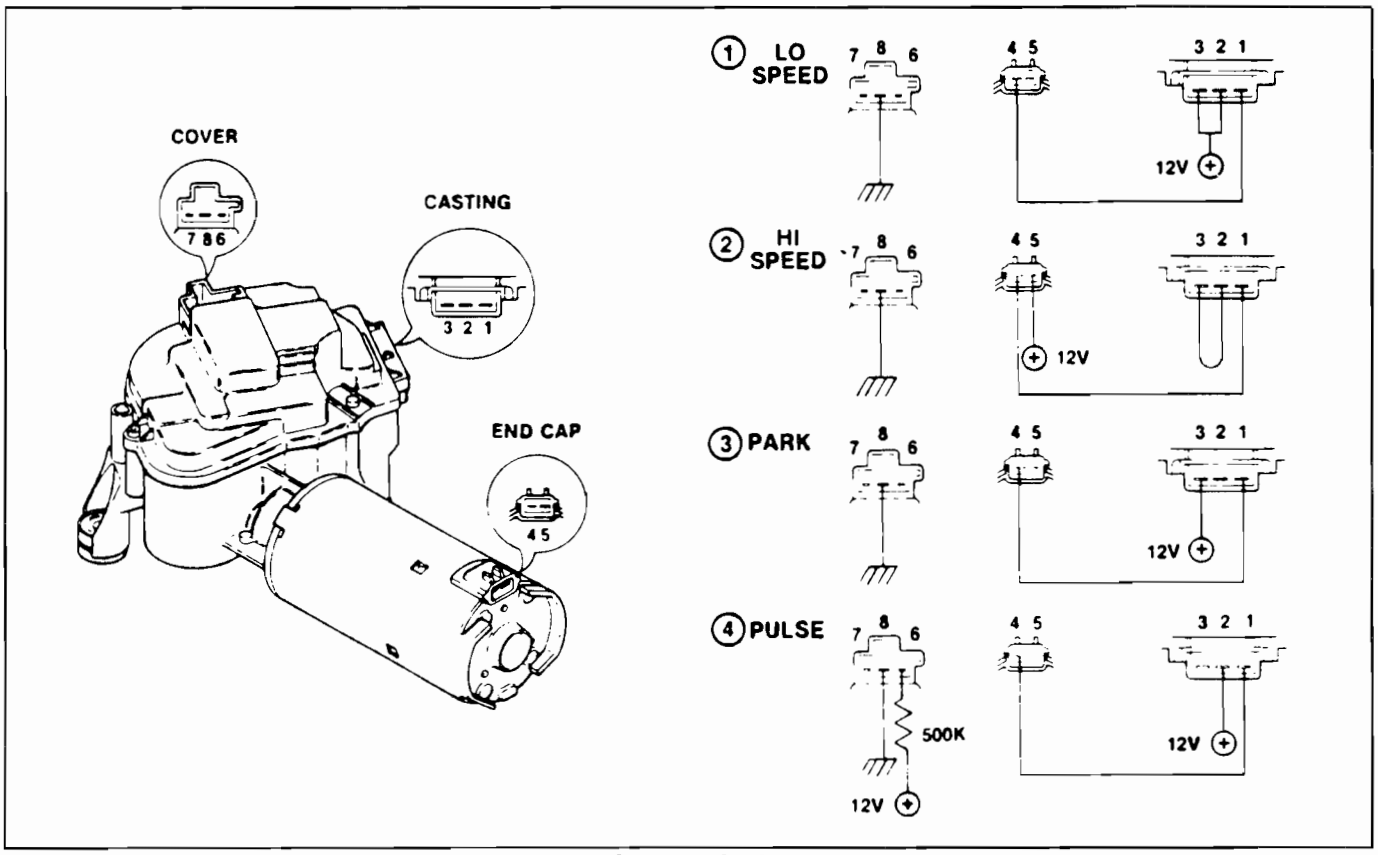


Figure 8E-3 Wiper On Car Check

DIAGNOSIS

The following procedures assume that the technician has checked the following:

1. Continuity of all harness wires.
2. Wiper motor to dash mounting screws tight.
3. Fuses.
4. Washer hoses clear.

WIPER MOTOR

Check for motor operation before removing from vehicle. Disconnect all wiring from wiper and perform the tests shown in Figure 8E-3 in sequence.

1. If wiper motor functions in all above modes, go to Wiper/Washer Switch Test.
2. If the motor does not function in any of the above checks, see Wiper and Washer Motor Diagnostic Chart.

WASHER PUMP

Check for washer pump operation before removing from vehicle. Remove cover connector and apply 12V(+) to #7 wiring harness terminal as shown in Figure 8E-4.

1. If motor does not run or pump water, replace washer pump.
2. If motor runs and pumps water, problem is in cover assembly or switch (See Wiper/Washer Switch Test).

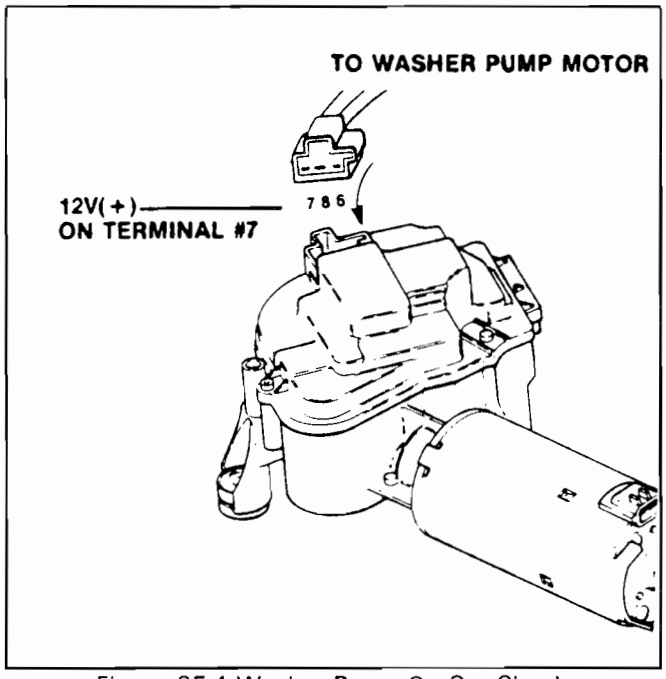
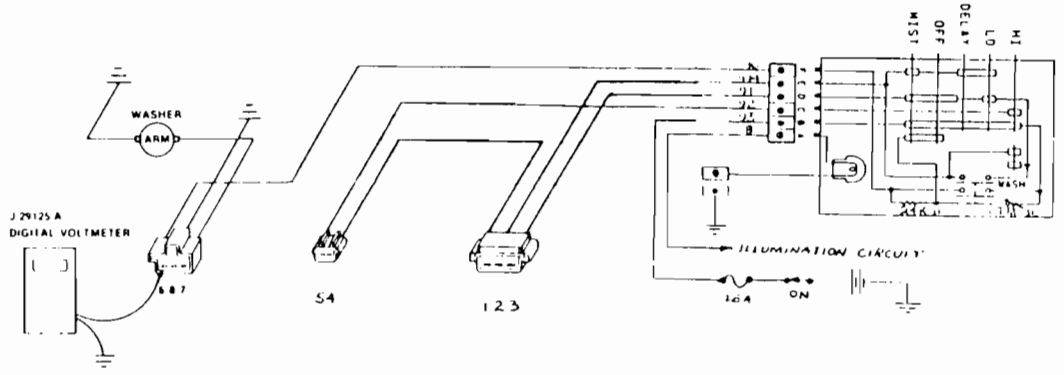


Figure 8E-4 Washer Pump On Car Check



SWITCH MODE / TERMINAL #	MIST	OFF	PULSE	LO	HI	WASH
1	C*	C*	C*	C*	C*	C*
2	12V(+)	—	12V(+)	12V(+)	—	—
3	12V(+)	12V(+)	—	12V(+)	—	12V(+)
4	C*	C*	C*	C*	C*	C*
5	—	—	—	—	12V(+)	—
6	10 TO 12 VOLTS			—	—	12V(+)
7	—	—	—	—	—	—
8	—	—	—	—	—	—

*C = continuity between terminals

[–] LESS THAN 1 VOLT

NOTE: All voltage readings taken with respect to vehicle ground.

Figure 8E-5 Wiper/Washer Switch Check

WIPER/WASHER SWITCH TEST

Disconect wiring harnesses from wiper motor and perform the tests shown in Figure 8E-5, using a digital voltmeter with ignition switch on.

To use the Wiper/Washer Switch Check Chart in Figure 8E-5, probe terminals 1 thru 8 with digital voltmeter and wiper switch in various positions.

WIPER & WASHER MOTOR DIAGNOSTIC CHART

SYMPTOM / PROBABLE CAUSE	Wiper system inoperative—all modes	Wiper won't shut off	Blades cycle in and out of park position	Wiper has Hi speed only—won't delay	Wiper inop in "Delay" mode, functions OK in other modes	Wiper won't delay between delay wipes	Wiper has Lo speed only	Wiper intermittent operation	Washer does not operate properly in demand or program modes
Defective cover/board	XX*				X	X			X
Motor defective	X			X			X	XX*	
Park switch defective		X	X						
Gear train damaged								X	

*Denotes most probable cause.

ON CAR SERVICE

WIPER MOTOR

Replacement

1. Open hood and install fender covers.
2. Remove wiper arms.
3. Remove air inlet leaf screen.
4. Turn ignition on, and activate motor with wiper switch. Allow motor crank arm to rotate to point to a position between 4 and 5 o'clock as viewed from passenger compartment. Stop crank arm in this position by turning off ignition switch.
5. Disconnect battery ground cable.
6. Disconnect upper motor electrical connectors.
7. Remove motor mounting bolts.
8. With crank arm in position described in Step 4 above, motor may now be removed from vehicle. Lower electrical connector may be disconnected as motor is partially removed.
9. To install, reverse the above procedure.

Park Switch Replacement

1. Remove housing cover from housing (Figure 8E-6).
2. If motor is in park position (Figure 8E-7), operate the motor as required to remove pawl from relay slot (Figure 8E-8).
3. Remove park switch assembly and replace with new assembly (Figure 8E-7). Return motor to park position (Figure 8E-7).
4. Install cover assembly onto wiper with **cam in position shown in Figure 8E-7 so as not to damage cam on drive pawl.**

Gear

Replacement

1. Clamp crank arm in vise and remove crankarm retaining nut, crank arm, upper seal cap, retaining ring., shim washers, shield and spacer washer. Then remove park switch assembly (Figure 8E-6).
2. Slide gear assembly out of housing. If intermediate gear only is to be replaced, the removal of the **entire** large gear assembly is required.
3. Slide drive plate and shaft out of gear and tube and remove the drive pawl, lock pawl and coil spring as required. Save the inside spacer washer for reassembly.
4. Remove intermediate gear retainer from shaft and then remove intermediate gear and replace, utilizing new retainer provided.
5. Reassemble drive pawl and lock pawl with spring.
6. Slide drive plate shaft into new gear. Move drive and lock pawls as required to allow their respective pins to fit in the gear pockets (Figure 8E-6). Make sure drive plate is firmly against gear.

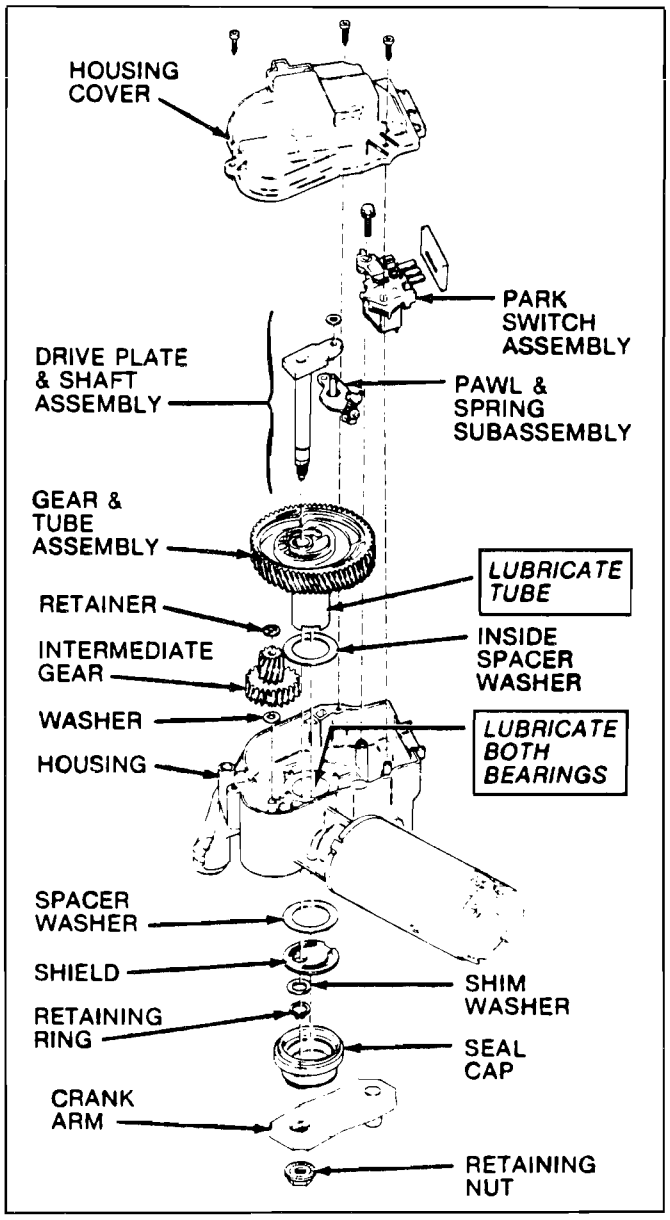


Figure 8E-6 Exploded View of Motor

7. Reinstall pawl spring between lock and drive pawls. Maintain the gear mechanism in its assembled position during Step 8.
8. Assemble inner spacer washer over the gear tube and lubricate tube and large output bearings (2) with provided grease. Then reassemble gear mechanism in housing (Figure 8E-6).
9. Reassemble parts removed in Step 1. Use shim washers as required to obtain 0.03 to 0.025mm (0.001 to 0.010 in.) end play.
10. Refer to Figure 8E-7 and operate wiper to park position; then position crank arm on output shaft flats so that it points in the direction shown in Figure 8E-6. Next, install crank arm retaining nut finger tight.
11. Clamp crank arm in vise and torque retaining nut to 34-51 N·m (25-38 ft. lb.).
12. Check for proper motor operation.

INSTALLATION OF END CAP AND ARMATURE ASSEMBLY

End Cap Assembly Replacement

1. Carefully bend retainer tabs outward as required to provide clearance for removing end cap assembly (Figure 8E-10).
2. Pull end cap assembly off the armature shaft and out of wiper housing.
3. Take new end cap assembly and raise brush retainer to hold back brushes (Figure 8E-11).
4. Carefully bend the 4 tabs back to secure the end cap in position.
5. Check wiper operation.

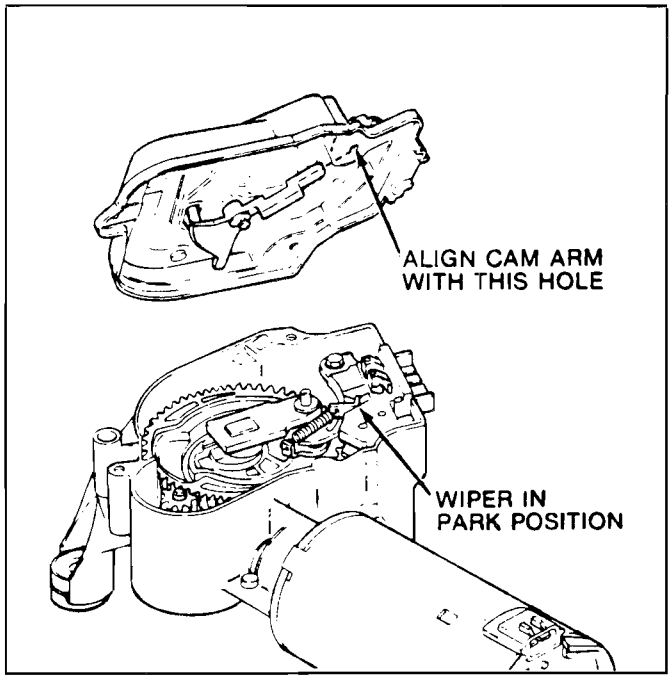


Figure 8E-7 Gear Assembly with Motor in Park Position

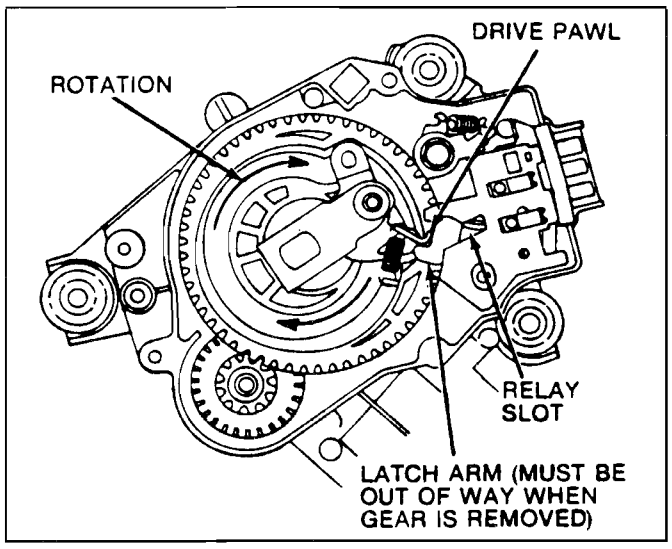


Figure 8E-8 Gear Removal

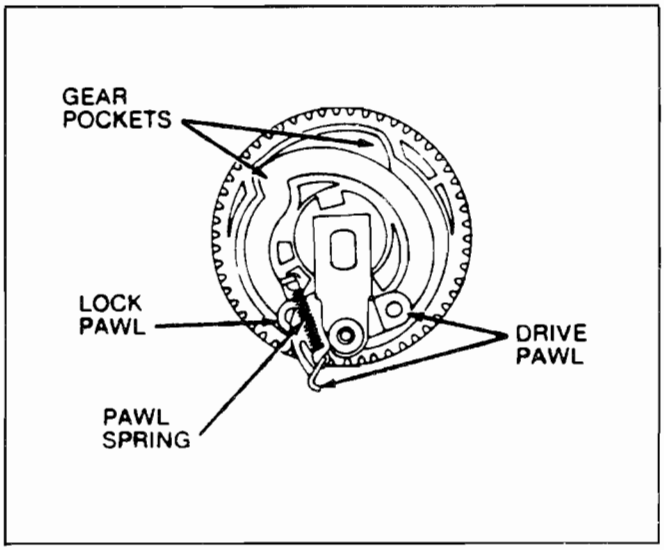


Figure 8E-9 Installing Drive Plate Shaft

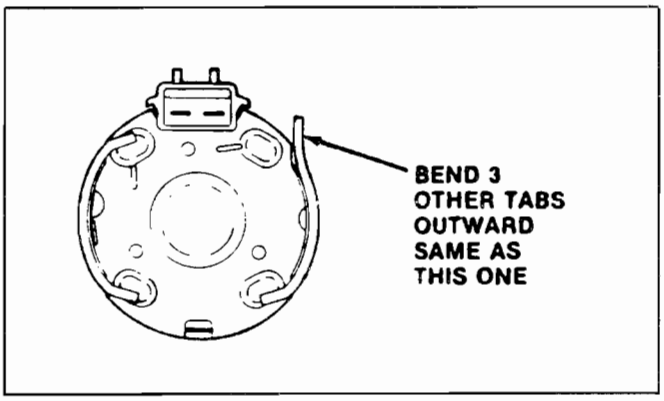


Figure 8E-10 Removing End Cap Assembly

Armature Assembly Replacement

1. Follow Steps 1 and 2 of end cap replacement.
2. Remove armature from housing being careful not to chip magnets with armature worm gear.
3. Carefully insert new armature through housing into motor bearing (Figure 8E-12).
4. Reassemble end cap by following Steps 3-5 of end cap assembly.

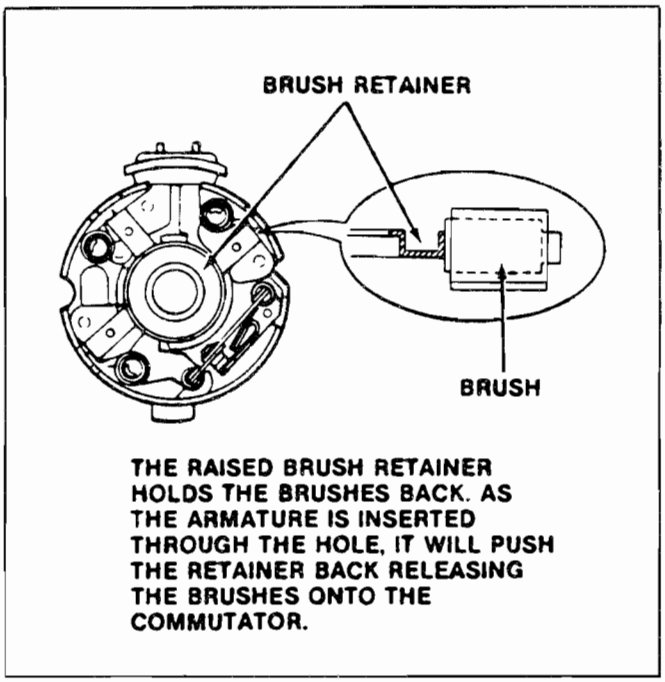


Figure 8E-11 Raising Brush Retainers

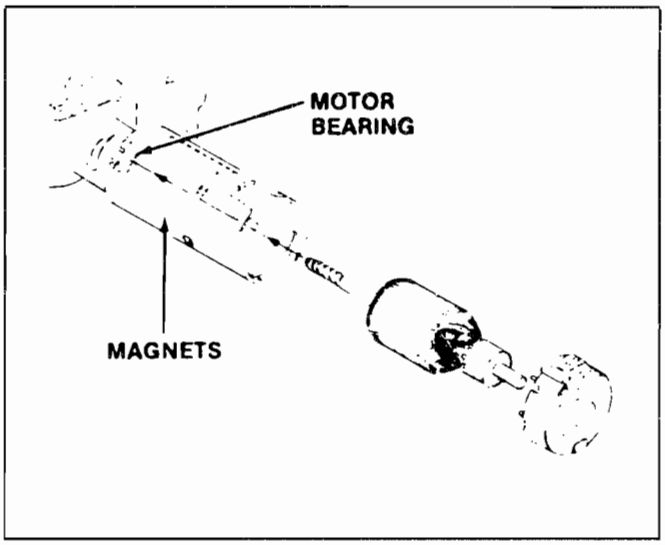


Figure 8E-12 Inserting Armature into Motor Bearing

SECTION 9
ACCESSORIES
CONTENTS

RADIO 9A

POWER ANTENNA 9B

CRUISE CONTROL 9C

SECTION 9A

RADIO

CONTENTS

RADIO
General Information 9A-1
Operating Instructions 9A-1
Diagnosis 9A-4
On-Car Service 9A-4

GENERAL INFORMATION

Speakers

NOTICE: All factory equipped sound systems have ungrounded speakers. Installing add-on tape players, CBs or other units that use the car speakers may damage your sound system and impair operation of the added unit. Please consult your dealer in advance if you are considering additions.

FM Reception

Although FM is normally static free, reception can be limited by terrain, atmospheric conditions, station strength and distance from the transmitter. Buildings or other obstructions can cause momentary static, flutter or station swapping. If you cannot keep good reception, tuning to a stronger station will bring improvement.

Stereo Sound

All factory equipped sound systems with an FM stereo radio will switch to stereo operation whenever an FM stereo broadcast is being received, and an indicator in the dial will light. "Stereo" operation means the radio is separating a stereo broadcast back into the original two channels, called "left" and "right. " Stereo sound is noticeably more realistic to the ear.

Power Antenna

The power antenna is controlled by the radio. When the radio is ON the antenna will go up. When the radio is turned OFF either by the ON/OFF knob or by turning the ignition switch to the OFF position, the antenna is designed to go down.

ETR AM-FM Stereo (Seek/Scan) with Clock (UM7 VF)

To Operate the ETR AM-FM Stereo Radio:

- **Power Button** ("PWR") – press to turn radio on. Press again to turn radio off.
- **Upper Knob** – rotate knob to control volume. Press knob to recall station frequency when listening to the radio with the ignition on, or to display time-of-day with ignition off.
- **Balance Control** (located behind upper knob) – turn to adjust left/right speaker balance.
- **Lower Knob** – rotate knob to tune radio stations manually. Frequency will be displayed during tuning. Press knob to select AM or FM band alternately.
- **Front/Rear Speaker Control** (located behind lower knob) – rotate control to adjust the sound between the front and rear speakers.
- **Bass and Treble Controls** – slide treble control up to increase treble, or down to decrease treble. Slide bass control up to increase bass, or down to decrease bass.
- **Pushbuttons**

  The radio has four pushbuttons you can use to select your favorite stations easily. You may select four AM and four FM stations for a total of eight selections.

  To Set Pushbuttons:

  1. Make sure the bandswitch is on the band you want. Then, tune in the desired station.
  2. Press SET button. The SET indicator light on the dial will light up. Then press one of the four station pushbuttons. The SET indicator light will go out.

     The radio will then tune to the selected station whenever you press the station button.
- **Seek and Scan**

  Use the SEEK and SCAN buttons for automatic station tuning.

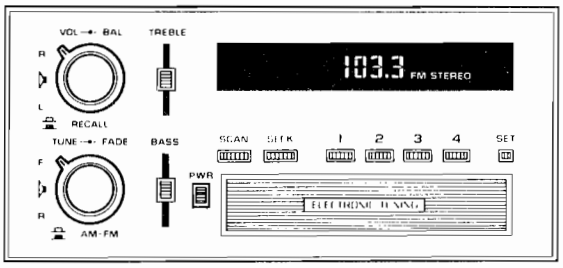
  Press SCAN button to sample each station being received automatically. To stop SCAN, press SCAN button again.

  The SCAN indicator light on the frequency dial will be lit during SCAN operation.

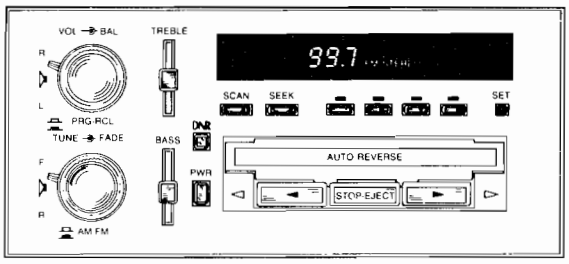
  Press the SEEK button to locate and retain the next listenable station on the band automatically.
- **Time Set:**

  To set hour, press SET button. The SET indicator light on the dial will then light up and the radio frequency will be displayed. Then press SCAN button, holding SCAN button in until correct hour appears.

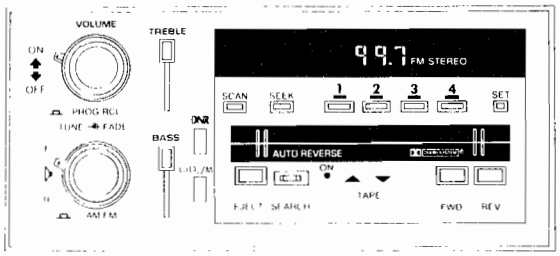
  To set minutes, press SET button. The SET indicator light will then light up and the radio frequency will be displayed. Then press SEEK



AM-FM STEREO, SEEK/SCAN
WITH CLOCK (UM7 VF)



AM-FM STEREO, CASSETTE, SEEK/SCAN
WITH CLOCK (UM6 VF)



DELCO-GM BOSE MUSIC SYSTEM
WITH CLOCK (UU8 VF)

Figure 9A-1 2000 Series Radios

button, holding SEEK button in until correct minute appears.

NOTE: After you press the SET button, the radio frequency will be displayed. The time-of-day will be displayed when you press the SCAN or SEEK button.

The FM stereo indicator will light up whenever an FM station is broadcasting in stereo. "Stereo" operation means the radio is separating a stereo broadcast back into the original two channels, called "left" and "right." Stereo sound is noticeably realistic to the ear.

ETR AM-FM Stereo (Seek/Scan) with Clock and Cassette (UM6 VF)

To Operate the ETR AM-FM Stereo Radio:

- **Power Button** ("PWR") – press to turn radio on. Press again to turn radio off.
- **Upper Knob** – rotate knob to control volume. Press knob to recall station frequency when listening to the radio with the ignition on, or to display time-of-day with ignition off. Press knob to select the other side of the tape when the cassette is playing.
- **Balance Control** (located behind upper knob) – turn to adjust left/right speaker balance.
- **Lower Knob** – rotate knob to tune radio stations manually. Frequency will be displayed during tuning. Press knob to select AM or FM band alternately.
- **Front/Rear Speaker Control** (located behind lower knob) – rotate control to adjust the sound between the front and rear speakers.
- **Bass and Treble Controls** – slide treble control up to increase treble, or down to decrease treble. Slide bass control up to increase bass, or down to decrease bass.
- **Pushbuttons**

  The radio has four pushbuttons you can use to select your favorite stations easily. You may select four AM and four FM stations for a total of eight selections.

  To Set Pushbuttons:

1. Make sure the bandswitch is on the band you want. Then, tune in the desired station.
2. Press SET button. The SET indicator light on the dial will light up. Then press one of the four station pushbuttons. The SET indicator light will go out.

   The radio will then tune to the selected station whenever you push the station button.

- **Seek and Scan**

  Use the SEEK and SCAN buttons for automatic station tuning.

  Press SCAN button to sample each station being received automatically. To stop SCAN, press SCAN button again.

  The SCAN indicator light on the frequency dial will be lit during SCAN operation.

  Press the SEEK button to locate and retain the next listenable station on the band automatically.

- **Time Set:**

  To set hour, press SET button. The SET indicator light on the dial will then light up and the radio frequency will be displayed. Then press SCAN button, holding SCAN button in until the correct hour appears.

  To set minutes, press SET button. The SET indicator light will then light up and the radio frequency will be displayed. Then press SEEK button, holding SEEK button in until correct minute appears.

  NOTE: After you press the SET button, the radio frequency will be displayed. The time-of-day will be displayed when you press the SCAN or SEEK button.

  The FM stereo indicator will light up whenever an FM station is broadcasting in stereo. Stereo (dual channel) sound is more realistic.

  FM & FM Stereo Broadcasts:

  FM broadcasts are "line-of-sight" from station antenna to receiving antenna. Range is often limited to 25 miles (40 km) or less for steady reception. Tall buildings or hills may cause flutter or noise which is not the fault of the radio.

  To Operate Tape Player:

  Insert cassette into tape door, with exposed edge entering first. Tape will snap into position when fully inserted. This automatically switches from radio to tape operation.

  After the cassette has snapped into position, adjust the volume and fader controls to your preference.

  To advance to the next selection quickly, press the button next to the lighted indicator. To listen to an earlier selection, press the button next to the unlighted indicator. To stop the forward or reverse movement press the STOP-EJECT button; press again to eject the tape.

  When the left indicator light is lit, the top side of the tape is playing. When the right indicator light is lit, the bottom side of the tape is playing.

  NOTE: When end-of-tape is reached in one direction, the unit will automatically play the other side of the tape.

  To remove the tape or listen to the radio, push the STOP-EJECT button.

  Press the Dynamic Noise Reduction (DNRTM) button to remove high frequency background hiss on AM, FM, FM stereo, and tape.

  For best results, 120 minute tapes are not recommended.

DELCO-GM/BOSE MUSIC SYSTEM W/CLOCK (UU8VF)

TO OPERATE THE ETR AM/FM STEREO RADIO:

- **Upper Knob** - Rotate knob to turn radio on or off and to control volume. To recall station frequency when listening to the radio, press knob. Or, press to momentarily display time of day with the ignition off. Press knob to select the other side of the tape when the cassette is playing.
- **Lower Knob** - Rotate knob to tune radio stations manually. Frequency will be displayed during tuning. Press knob to alternately select AM or FM band.
- **Front/Rear Speaker Control** (located behind lower knob) - Rotate control to adjust the sound between the front and rear speakers. One of the things that makes the Delco-GM/Bose Music System unique is that the custom equalization of the car body interior has eliminated the need for a left/right balance control since proper left/right balance has been designed into the system.
- **Bass and Treble Controls** - Slide treble control up to increase treble or down to decrease treble. Slide bass control up to increase bass or down to decrease bass. NOTE: The normal position for the bass and treble controls on the Delco-GM/Bose Music System is to be all the way "up." However, if you are receiving a weak stereo signal, you may experience high frequency noise. To reduce the high frequency emphasis, slide the treble control down.
- **Favorite Station Buttons** - This radio has four buttons you can use to select your favorite stations easily. You may select four AM and four FM stations for a total of eight selections.

  To Set Favorite Station Buttons:

  1. Tune in the desired station on the AM or FM band.
  2. Push SET button.
  3. Push one of the four buttons.

     The radio will now tune to the selected station whenever you press the station button.

- **Seek and Scan** - Use the SEEK AND SCAN buttons for automatic station tuning.

  Press SCAN button to sample each station being received automatically. To stop SCAN, press SCAN button again.

  The SCAN indicator will be lit during SCAN operation.

Press the SEEK button to locate and retain the next listenable station on the band automatically.

- **Time Set** - To set the hour, press SET button. The SET indicator will then light up on the display and the radio frequency will be displayed. Then, press SCAN button and hold in until the correct minutes appear.

  To set the minutes, press SET button. The SET indicator will then light up on the display and the radio frequency will be displayed. Then, press SEEK button and hold in until the correct minutes appear.

  NOTE: After you press the SET button, the radio frequency will be displayed. The time of the day will be displayed when you press the SCAN or SEEK button.

TO OPERATE TAPE PLAYER:

- Insert cassette into tape door, with exposed edge entering first. Tape will snap into position when fully inserted. This automatically switches from radio to tape operation.
- **Forward Button (FWD)** - Press to advance tape. To stop forward motion, press the REV button lightly.
- **Reverse Button (REV)** - Press to reverse direction. To stop reverse motion, press the FWD button lightly.
- **Tape Eject Button (EJECT)** - Press to eject tape.

  NOTE: We do not recommend the use of any cassette tapes over C-90 in playing length.
- **Tape Indicator Lights (triangle shape)** - When the left indicator light is lit, the top side of the tape is playing. When the right indicator light is lit, the bottom side of the tape is playing.

  NOTE: When end of tape is reached in one direction, the unit will automatically play the other side of the tape.
- **Music Search Control (SEARCH)** - To listen to the next selection, slide SEARCH control to the right and then press the FWD button. The tape will then advance to the beginning of the next selection and begin playing.

  To listen to the present selection again, slide SEARCH button to the right and then press the REV button. The tape will then reverse to the beginning of the present selection and begin playing.

  For the SEARCH function to work properly there must be at least five blank seconds between selections.

  The "on" light will be lit while the SEARCH function is engaged.
- **Dynamic Noise Reduction Button (DNRTM)** - Removes high frequency background hiss on AM, FM, FM stereo, and cassette tapes. Press button "in" to activate DNR. We suggest you always leave DNR on.

  Your cassette is equipped with Dolby® noise reduction. This reduces high frequency hiss on tapes. This feature is automatic.
- **Tape Equalization Button (CrO_2/M)** - Select the 70 usec (press button in) or 120 usec (leave button out) setting, depending on the bias of your tape. The equalization setting that is desired will vary according to the type of tape being used. Chrome and metal tapes have 70 usec equalization, while iron tapes have 120 usec equalization.

DIAGNOSIS

See Section 8A - Electrical Diagnosis.

ON-CAR SERVICE

RADIO RECEIVER REMOVAL

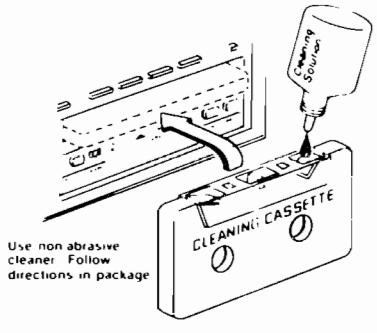
Refer to Section 8C, Instrument Panel and Gages.

POWER ANTENNA

See Section 9B.

TAPE AND TAPE PLAYER CARE

See Figure 9A-2



Optimum performance can be maintained by cleaning the internal tape head, capstan, and pinch roller periodically (approx. each 100 hours of operation). This can be done by inserting a nonabrasive cleaning cassette in place of the music tape.

Store cassettes away from extreme heat or direct sunlight. Protect the open ends from dirt or damage; store them in their original cases or other protective cases.

For best results, 120 minute tapes are not recommended.

When leaving the car, cassettes may be left in the tape player if the deck is the "auto reverse" type (tapes are either automatically ejected or internally protected). In other models, tapes should be removed to prevent possible damage to the tape or tape player.

Figure 9A-2 Tape And Tape Player Care

SECTION 9B

POWER ANTENNA

CONTENTS

General Description 9B-1
Operation 9B-1
Wiring Circuits 9B-2
Unit Repair 9B-2
Housing and Cover Disassembly 9B-2
Mast and Tube Assembly 9B-3
Limit Switch Assembly 9B-4
Armature, Field Assembly 9B-4
Gear Assembly 9B-4
Diagnosis 9B-7
On-Car Service 9B-11

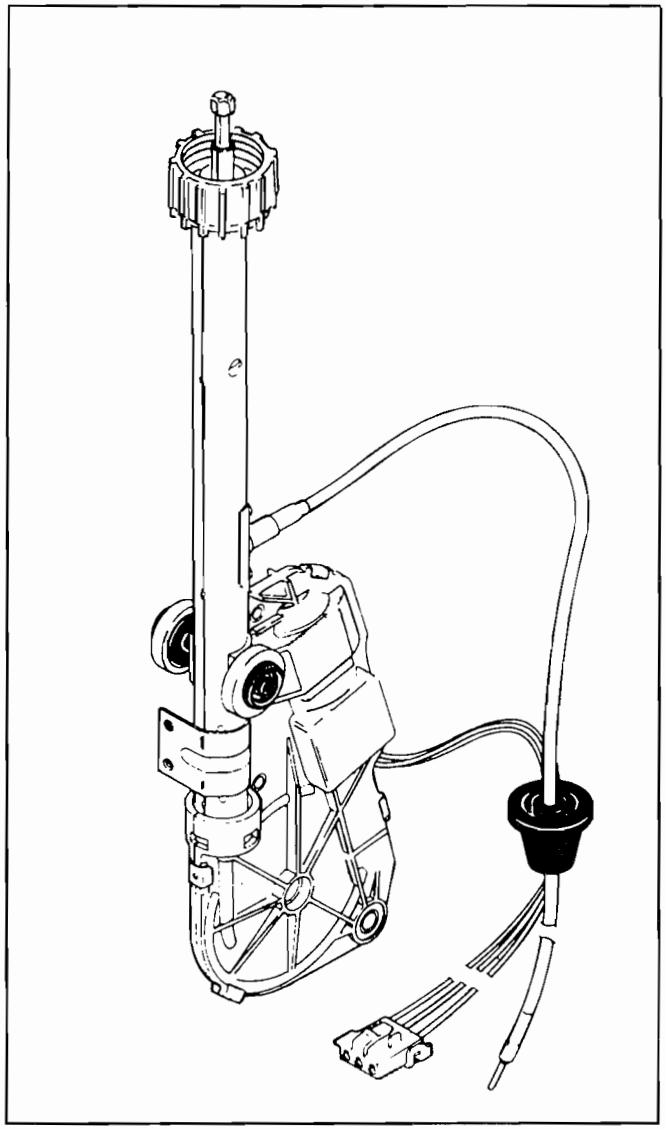


Figure 9B-1

GENERAL DESCRIPTION

The "Slimline Mini-Mast" type antenna is similar in design to previous models both in physical appearance and internal construction except that the mast is 23mm dia. instead of 29mm dia.

As shown in Figure 9B-1, a plastic housing consisting of two halves is attached to the mast and tube assembly. The housing contains the permanent magnet motor parts, limit switch assembly, drive gear and drive cable storage spool. Sealer is used between the two housing halves to prevent water entry and they are held together with 5 snap-on clips and 4 eyelets.

The motor armature is protected by an automatic reset type circuit breaker which is located on the limit switch assembly.

OPERATION

Raising and Lowering Mast

As with past model designs, the mast sections are extended and retracted by a plastic drive cable attached to the top section of the mast. The other end of drive cable is attached directly to the drive gear by means of a metal hook (Figure 9B-2).

Automatic shut off, when the mast reaches the full up or down position, is accomplished by the thrust of the armature tripping a reaction switch assembly.

The reaction switch assembly (Figure 9-2) consists of two snap action type switches. One shuts off the motor when the antenna is full up -- the other when the antenna is down. Direction of armature thrust depends on armature rotation (CW of CCW).

To understand how armature thrust actuates the reaction switches, think of the armature worm as threads on a bolt. Next, think of the drive gear teeth as threads on a nut that is held in a fixed position (i.e., when the mast reaches the full up or down positions and the gear stops turning).

The continuing rotation of the armature when the gear stops turning causes the armature worm to act like a bolt being screwed in or out of a nut held in a fixed position. This causes the armature to move fore or aft depending on rotation.

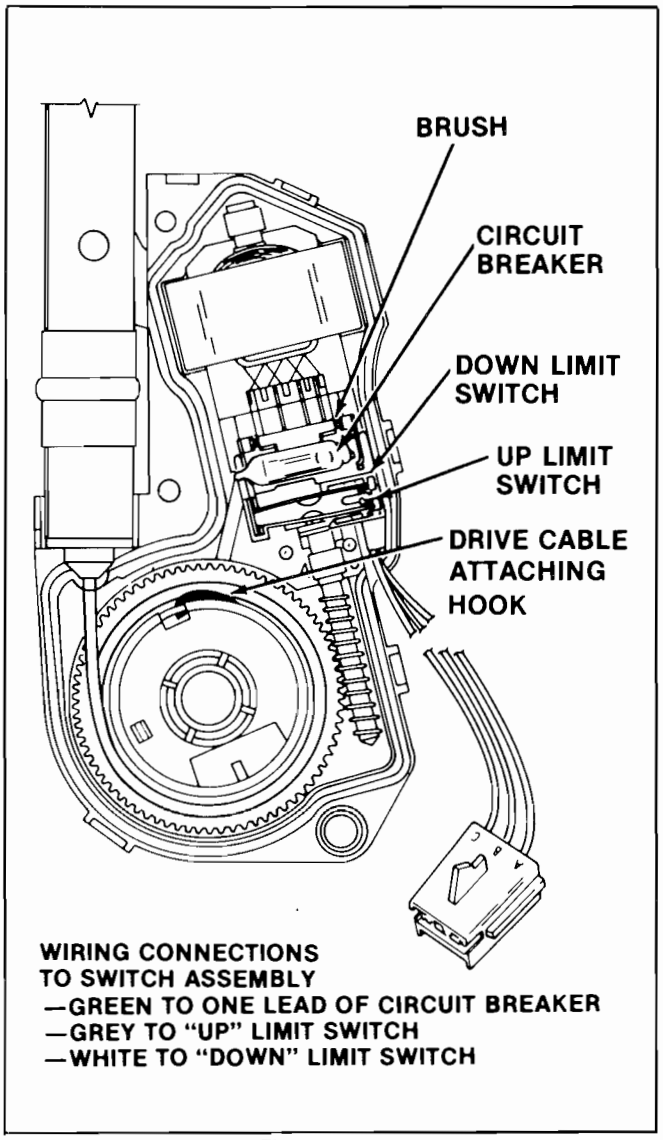


Figure 9B-2

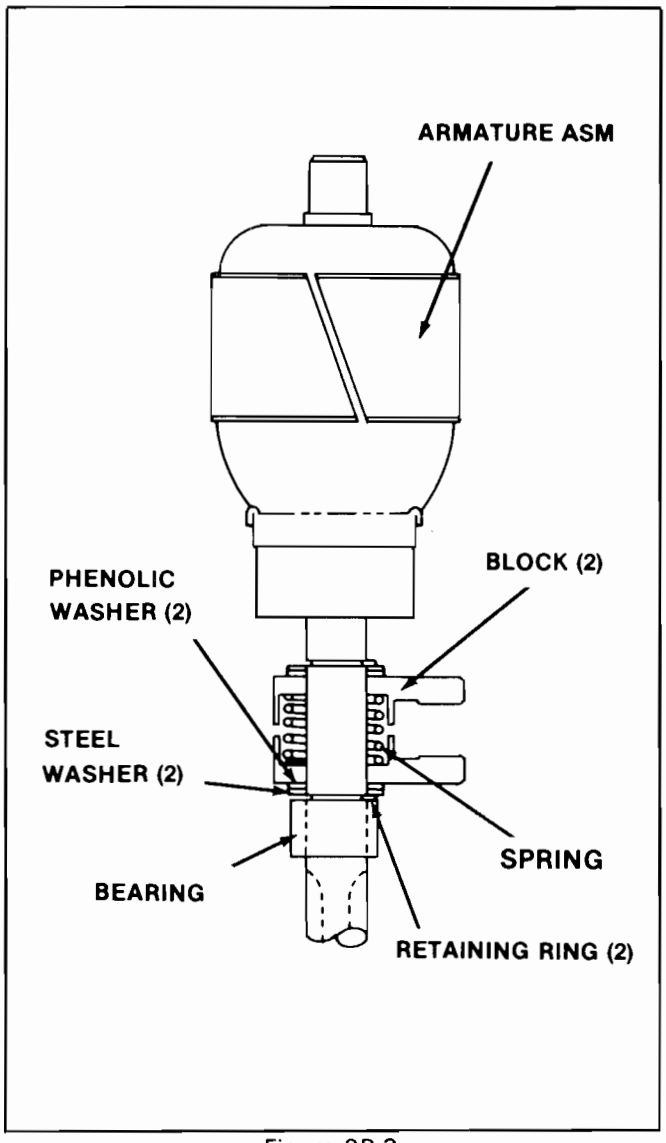


Figure 9B-3

The mechanism which permits the armature to thrust back and forth when the antenna mast reaches full extension or retraction is constructed as follows:

A spring loaded thrust mechanism consisting of two blocks and a load spring is assembled on the armature shaft. The mechanism is held in a fixed location on the shaft by two retainers (Figure 9B-3).

When the armature assembly is installed in the housing, the thrust mechanism fits into a cavity in the housing (Figure 9B-4). The spring load between the two thrust blocks prevents the armature from thrusting fore or aft until the drive gear stops turning.

As explained previously, when the mast reaches the full up or down position and the gear stops turning, the continuing rotation of the armature causes it to move fore or aft depending on rotation. As it moves fore or aft, it moves one of the thrust blocks toward the other compressing the load spring. After the thrust block has been moved a pre-determined distance, it triggers a limit switch to open the motor circuit. Refer to Figure 9B-2 to identify which thrust block and limit switch controls motor shut off when the mast reaches the up or down positions.

All "Slimline" type of antennas are automatic type.

WIRING CIRCUITS

With the ignition switch "ON" and the radio turned "ON", the antenna motor automatically raises the mast to the full up position.

- AM-FM -- 31-1/4"

Turning the radio or ignition switch off automatically causes the antenna motor to lower the mast to full down position. Refer to Figures 9B-5 and 9B-6 for circuit diagrams.

UNIT REPAIR

NOTICE: All service procedures shown require opening the motor and gear housing.

HOUSING AND COVER DISASSEMBLY

1. Remove the four(4) eyelets (Figure 9B-7). Bolts and nuts are provided in the various service packages for reassembling the housing and cover.
2. Remove the five(5) retaining clips.

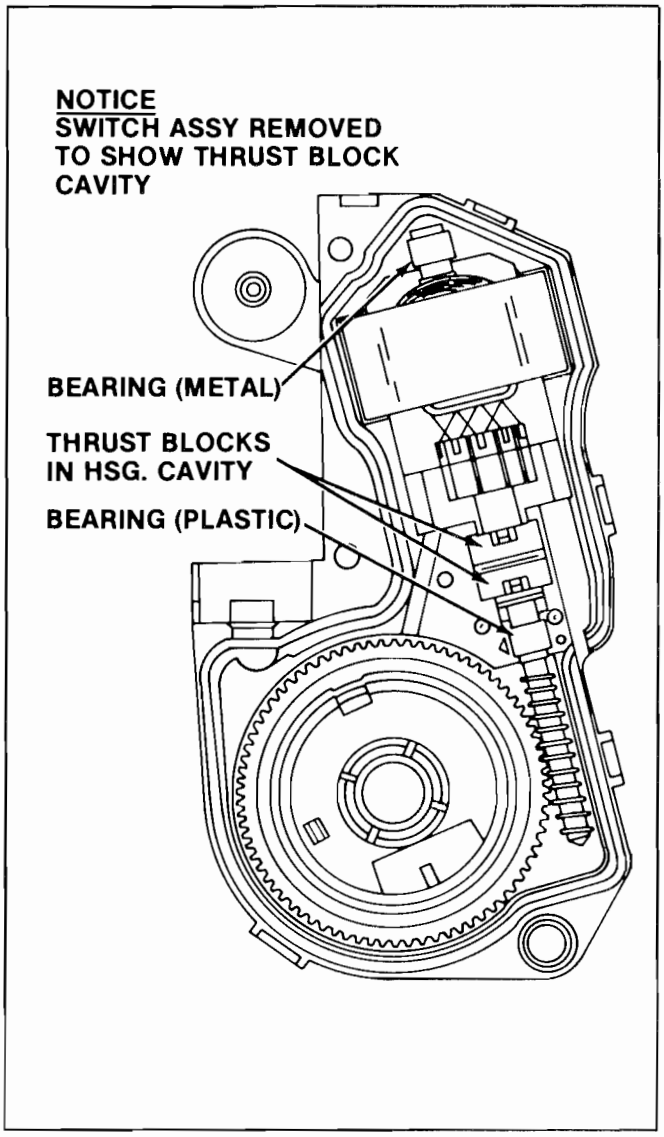


Figure 9B-4

3. Using a small screwdriver, carefully wedge the cover off the housing. Special slot locations have been molded in the housing behind the clips.
4. Clean off any excess and/or loose sealer from the cover and housing.

MAST AND TUBE ASSEMBLY

Removal

1. Follow Steps 1 thru 4 under housing disassembly.
2. Separate mast and tube assembly from gear housing and unwind cable from gear spool as required to gain access to attaching hook.
3. Unhook end of cable from gear (Figure 9B-8).

Installation

1. Extend replacement mast as required until approximately 10 inches (250mm) of cable is left exposed.
2. Hook end of cable in gear and route cable in spool as shown in Figure 9B-8.
3. Position the mast and tube assembly on the housing so that the rubber drain pipe fits into the housing hole and the mounting ears are located in the housing slots (Figure 9B-8).
4. Push excess drive cable into the tube assembly as required to maintain the cable in the gear spool.
5. Position cover on gear and motor housing and install the 2 nuts and bolts that attach the mast and tube assembly to housing. Next, install the other two bolts and nuts and the five retainer clips.

   NOTICE: For isolation mount unit, re-install grommets in housing.

6. Check antenna operation. Refer to figure in Step 1 under Diagnosis procedure for "In-operative Antenna".
7. Apply sealer (GE-162 or equivalent) around the entire edge of the housing and cover; also the area where the tube fits into the plastic housing.

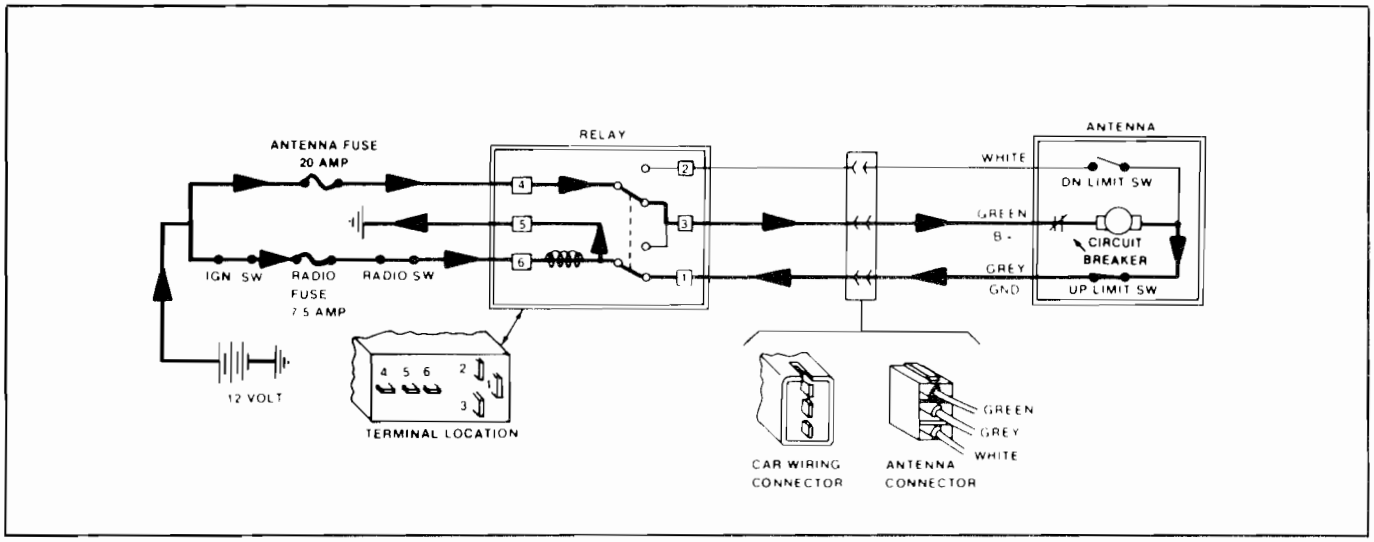


Figure 9B-5 Typical Wiring - Extend

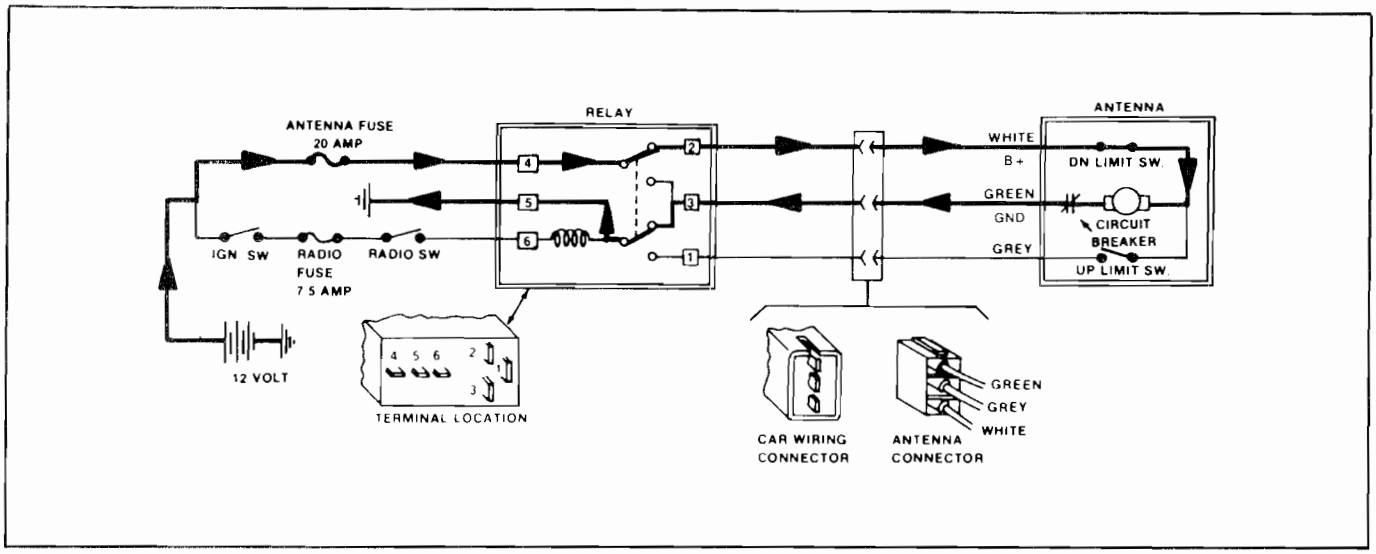


Figure 9B-6 Typical Wiring - Retract

LIMIT SWITCH ASSEMBLY

(Includes Motor Brushes, Circuit Breaker and Leads)

Removal and Installation

1. Follow Steps 1 thru 4 under "Housing and Cover Disassembly".
2. Remove excess sealer in area where leads extend out of housing and lift the switch assembly out of housing (Figure 9B-9).
3. Install replacement switch assembly in housing.
4. Follow Steps 3 thru 7 under "Installation of Mast and Tube Assembly". NOTICE: Extend mast as required so that plastic drive cable will not interfere with reassembly of cover on housing.
5. Reseal area where leads extend out of housing.

ARMATURE, FIELD ASSEMBLY

Removal and Installation

1. Follow Steps 1 thru 4 under "Housing and Cover Disassembly".
2. Remove limit switch assembly.
3. To remove armature and field together, pull out at the field end (Figure 9B-9).
4. Replace armature and/or field as required and reassembled in housing.
5. Reinstall switch assembly.
6. Follow Steps 3 thru 7 under "Installation of Mast and Tube Assembly".

GEAR ASSEMBLY

NOTICE: It is not necessary to remove switch assembly and armature or field assembly to remove gear.

Removal and Installation

1. Follow Steps 1 thru 4 under "Housing Disassembly".
2. Follow Steps 2 and 3 under "Mast and Tube" removal.
3. Slide gear off housing post. It may be necessary to grasp hub of gear with a pair of pliers (Figure 9B-9).
4. Install replacement gear and follow Steps 1 thru 7 under "Mast and Tube Installation".

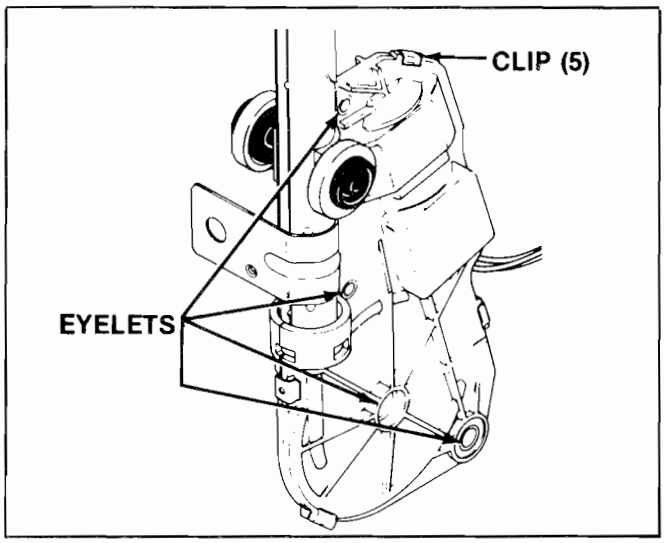


Figure 9B-7

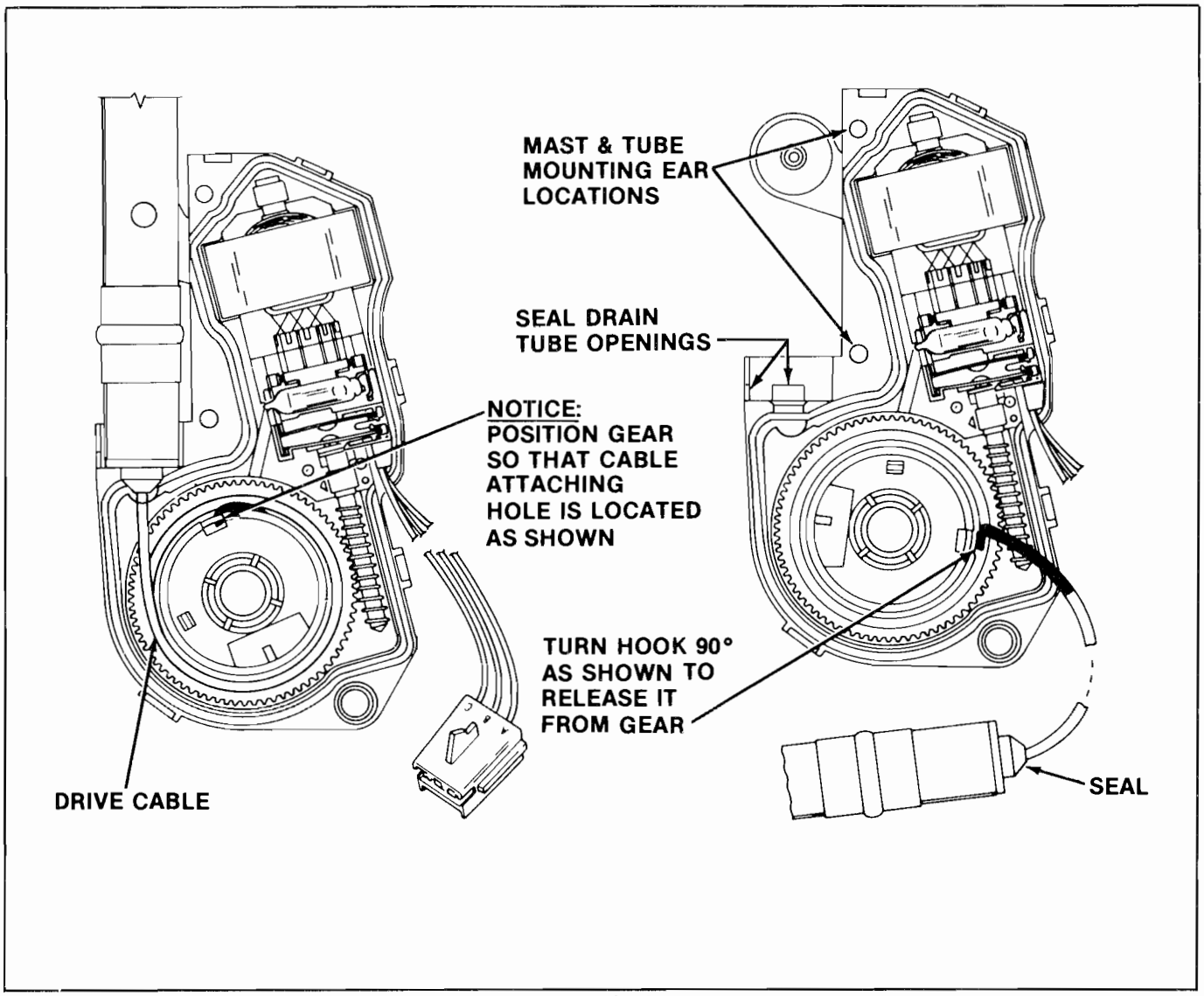
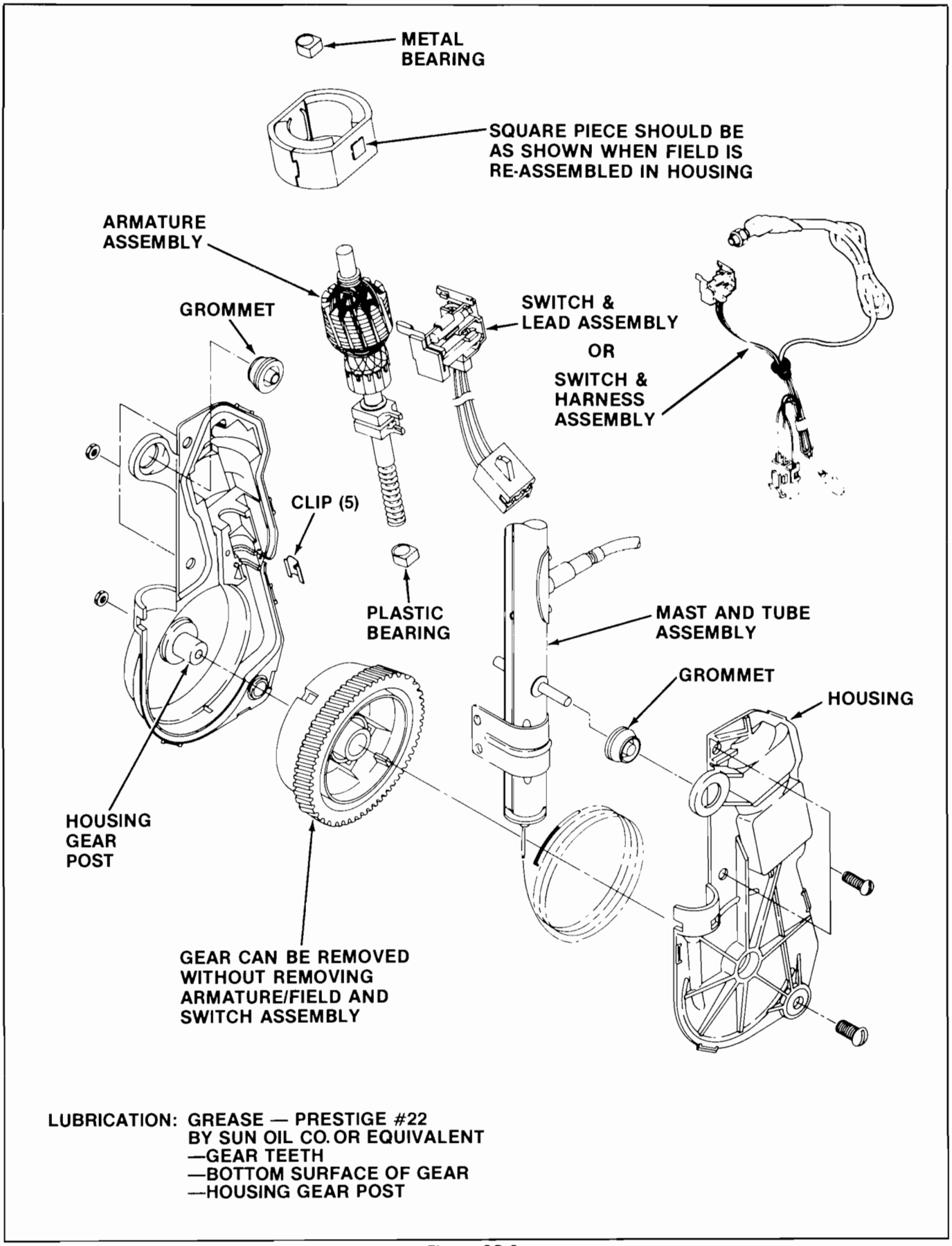

MAST & TUBE
MOUNTING EAR
LOCATIONS
SEAL DRAIN
TUBE OPENINGS
NOTICE:
POSITION GEAR
SO THAT CABLE
ATTACHING
HOLE IS LOCATED
AS SHOWN
TURN HOOK 90°
AS SHOWN TO
RELEASE IT
FROM GEAR
DRIVE CABLE
SEAL

Figure 9B-8



LUBRICATION: GREASE — PRESTIGE #22
BY SUN OIL CO. OR EQUIVALENT
—GEAR TEETH
—BOTTOM SURFACE OF GEAR
—HOUSING GEAR POST

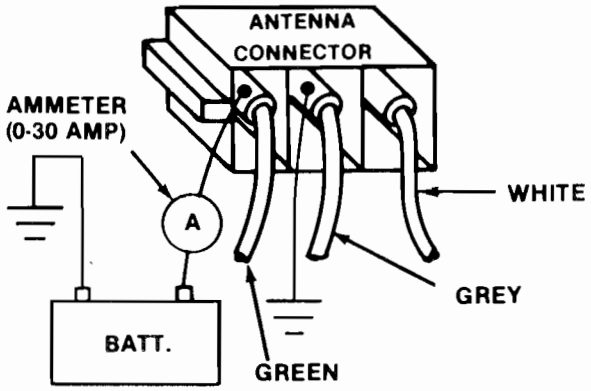
Figure 9B-9

DIAGNOSIS PROCEDURES

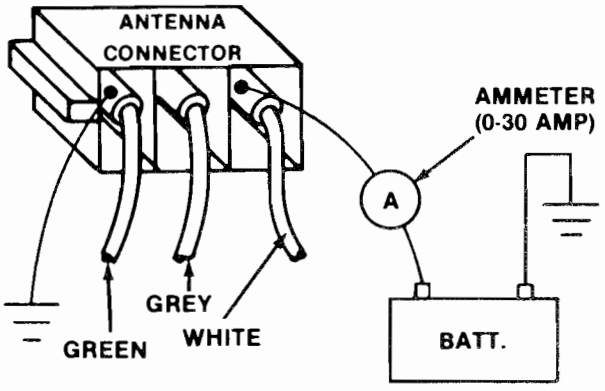
ANTENNA INOPERATIVE

STEP 1 Try operating antenna independently of car wiring as shown and observe current draw.

EXTEND-UP CYCLE



RETRACT-DOWN CYCLE



CURRENT DRAW SPEC. @ 12.0 VDC

	AMPS
(1) MAST EXTENDING OR RETRACTING	3.0
(2) STALL CURRENT	10.5 (COLD) MAX.

ANTENNA INOP

ANTENNA RUNS BUT CURRENT DRAW EXCESSIVE

Repair or replace antenna as req'd.

NOTICE: If current draw is excessive, be sure to check antenna fuse when repaired antenna is installed.

ANTENNA OK

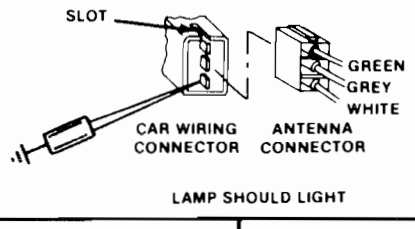
Go To STEP 2

Diagnosis Chart 1A

ANTENNA INOPERATIVE (CONT.)

STEP 2 Disconnect car wiring from antenna and connect test light to car wiring connector as shown below:

Ignition Sw. "OFF"



OFF

Check Antenna Fuse

BLOWN

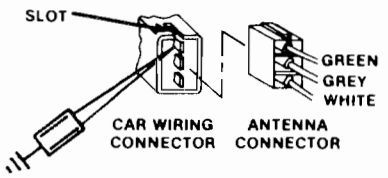
Replace fuse and recheck system. If fuse blows again, problem is in wiring or relay.

OK

Check relay per STEP 4 Tests "A" and "B"

ON

Ign. Sw. "ON". Radio Sw. "ON"



ON

Check wiring connections at relay. If they appear OK problem is in relay.

OFF

Go To STEP 3

STEP 3 With ignition switch on, turn radio switch "off" and "on" and listen for relay "click" (wiring disconnected from antenna).

NO CLICK

Check Radio Fuse

BLOWN

Replace fuse and recheck system. If fuse blows again, check for shorted condition in wiring to relay terminal no. 6, relay or radio.

OK

Check circuit to relay STEP 4, Test "C"

If circuit to relay checks OK, check ground circuit from no. 5 relay terminal. If ground circuit checks OK, relay is problem.

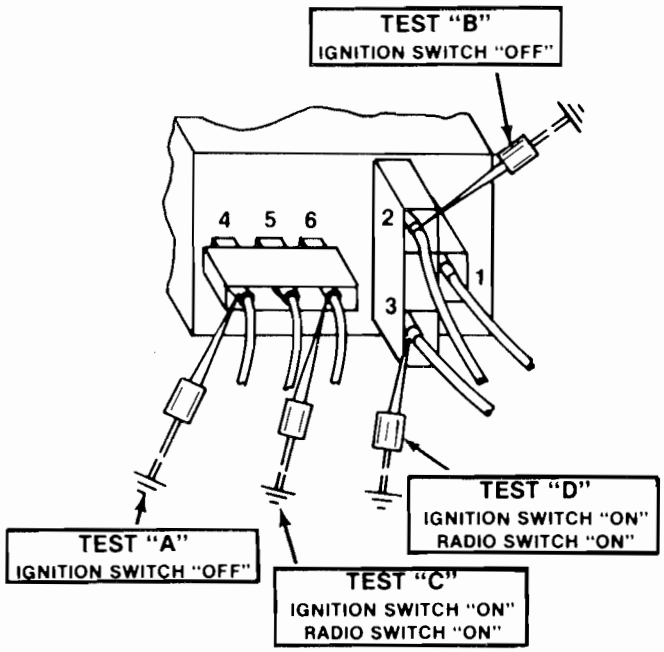
CLICKS

Check relay per STEP 4 Test "D".

If relay check OK, look for an open condition in wire between relay and antenna.

ANTENNA INOPERATIVE (CONT.)

STEP 4 **Checking Relay Circuits: (Antenna Disconnected)**



TEST	TEST LIGHT	ANALYSIS
A	ON	— 12V circuit from antenna fuse to relay OK.
	OFF	— Fuse blown or wire open to relay terminal 4.
B	ON	— Circuit thru relay OK.
	OFF	— Replace relay.
C	ON	— 12V circuit via radio fuse and radio sw to relay OK.
	OFF	— Radio fuse blown; radio switch open; wiring open.
D	ON	— Circuit thru relay OK.
	OFF	— Replace relay.

ANTENNA MOVES UP AND DOWN BUT DOES NOT EXTEND TO FULL UP POSITION AND/OR RETRACT TO FULL DOWN POSITION

PROCEDURE	RESULT
STEP 1 Inspect antenna mast sections for a dirty or bent condition. Make necessary repairs and recheck antenna operation. **NOTICE:** If antenna mast is dirty, clean it first then wipe off mast with a cloth dampened with light oil. May require several operations of antenna before it comes clean.	**ANTENNA OPERATES CORRECTLY AFTER REPAIRS** End of test. **PROBLEM NOT CORRECTED.** *Go to STEP 2.*
STEP 2 Remove antenna assembly from vehicle and disassemble mast and support tube from motor drive unit. Manually extend and retract the mast sections and observe if sections move freely.	**MAST SECTIONS EXTEND AND RETRACT EASILY.** Check for correct wiring connections to gear box switch. Replace switch as req'd. See Figure 2. **BINDING CONDITION IN MAST.** Replace mast assembly.

ANTENNA MOTOR RUNS BUT ANTENNA MAST DOESN'T MOVE

OR

ANTENNA MOTOR WILL NOT SHUT OFF

PROCEDURE	RESULTS
STEP 1 Manually try to move the top section of the mast up or down.	**TOP SECTION MOVES UP AND DOWN.** Replace mast and tube assy. **TOP SECTION DOESN'T MOVE.** Disassemble motor/gear box. Check mast assy for a jammed condition. If no jammed condition exists, repair motor/drive unit.

RADIO RECEPTION POOR OR NONE AT ALL (ANTENNA EXTENDS AND RETRACTS OK)

CHECK THE FOLLOWING:

1) RF cable connections at radio and antenna unit. (Note: Chevrolet has a 3rd connection.)

2) Antenna *mast* is not grounded. (Telescoping rod sections)

3) Check continuity between antenna R.F. pin and mast.

4) Antenna support tube is securely grounded.

5) Antenna mast for a dirty condition.

Diagnosis Chart 2

ON-CAR SERVICE

POWER ANTENNA

Remove and Install (Figs. 9B-10 and 9B-11)

1. Disconnect battery ground.
2. Open hatch and remove rear trim panel.
3. Disconnect power antenna lead to relay.
4. Remove left side trim.
5. Remove luggage shade (if equipped).
6. Remove carpet trim, left side, and pull back carpeting.
7. Remove left side trim panel.
8. Raise vehicle.
9. Remove inner fender screws and brace open to gain access.
10. Remove antenna ground strap.
11. Disconnect plastic nut at top of mast.
12. Remove antenna bracket nuts.
13. Remove power lead and antenna lead through body.
14. Remove antenna.
15. Transfer bracket and ground strap.
16. For installation reverse removal procedure.

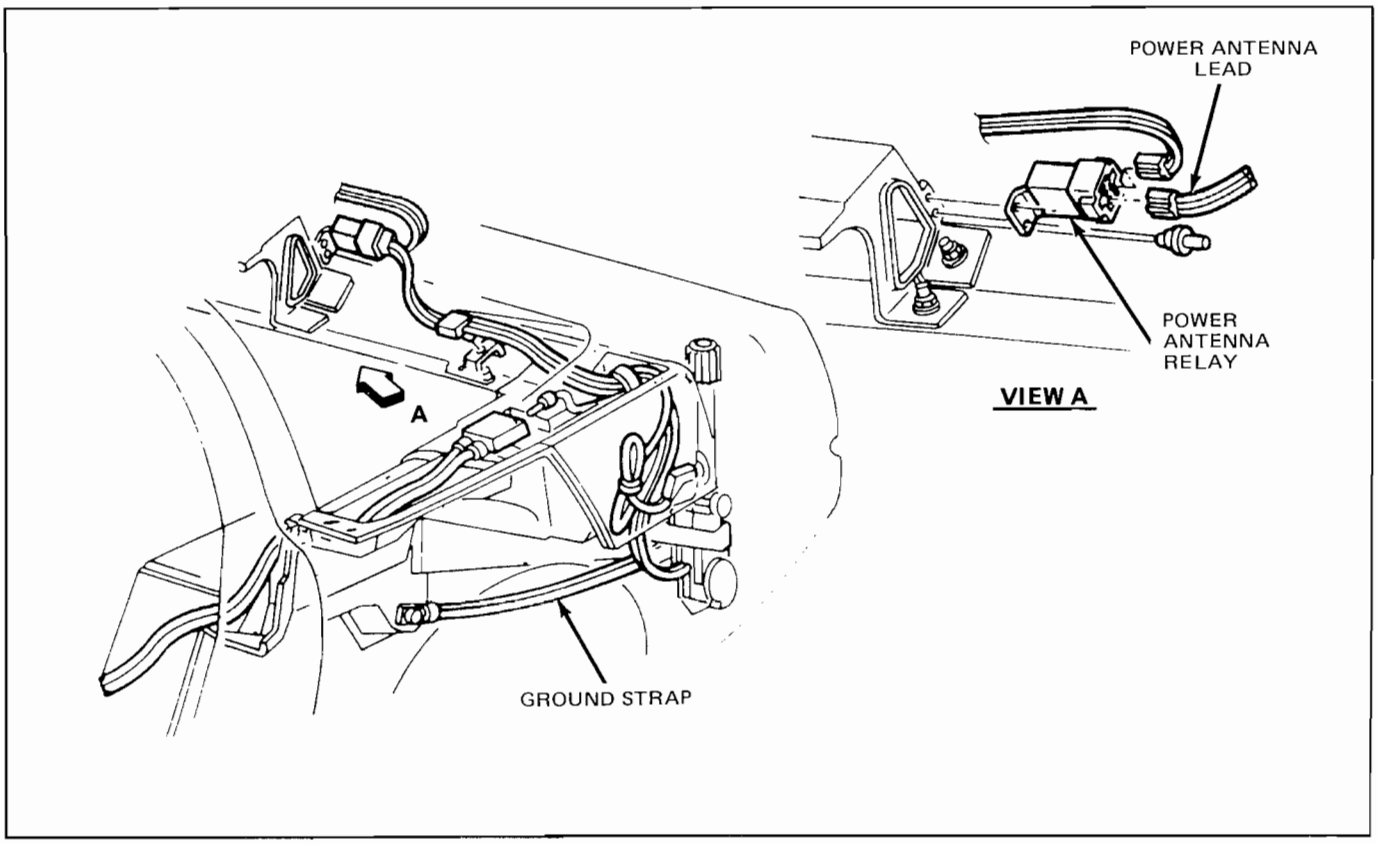


Figure 9B-10— Antenna Relay

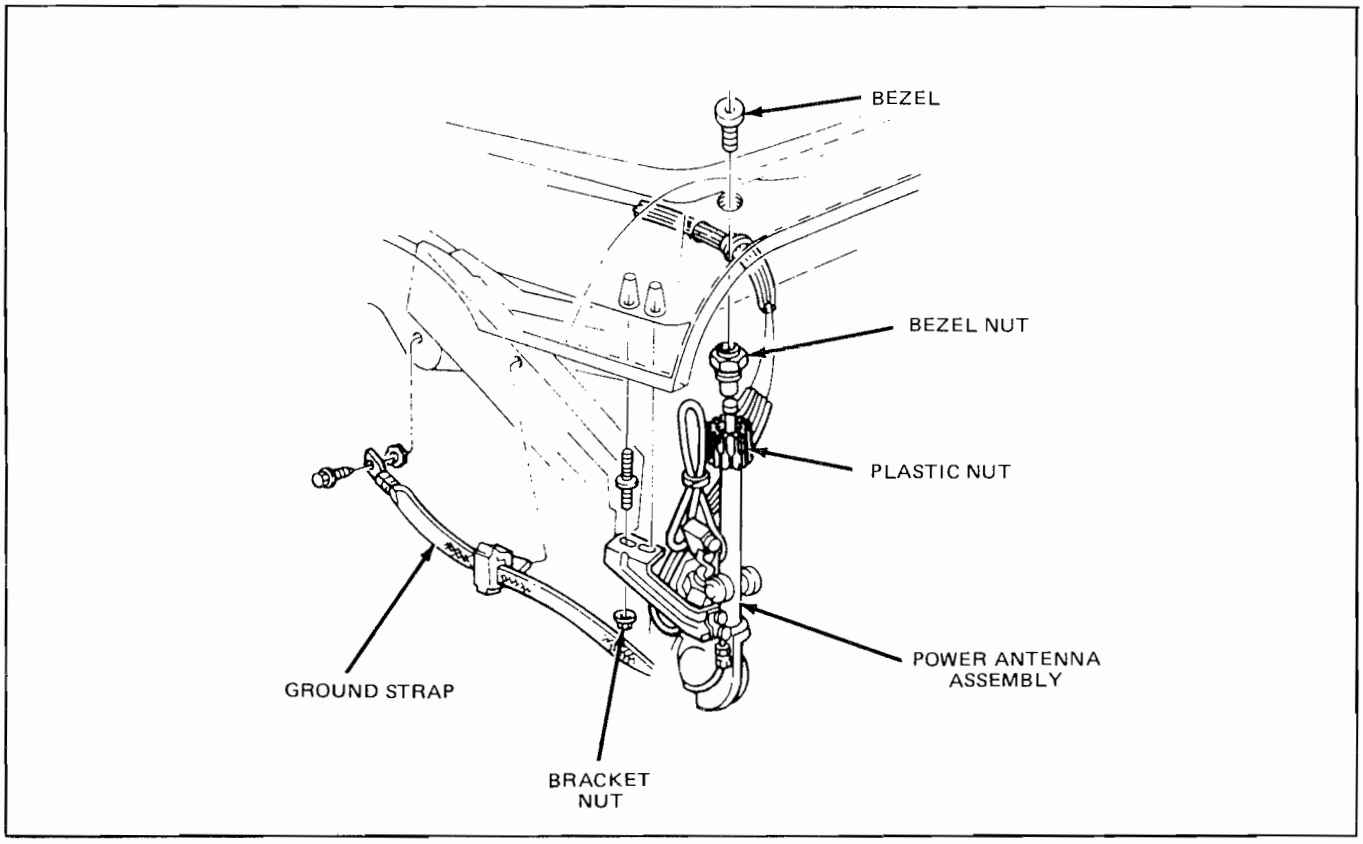


Figure 9B-11 — Power Antenna Installation

SECTION 9C

CRUISE CONTROL

CONTENTS

GENERAL DESCRIPTION 9C-1
Vacuum Supply 9C-1
Electrical & Vacuum Release Switches 9C-1
ON-CAR SERVICE 9C-1

GENERAL DESCRIPTION

Electronic Cruise Control is a speed control system which maintains a desired car speed under normal driving conditions. The main parts of the cruise control system are the mode control switches, controller (module), servo unit, servo cable, speed sensor, vacuum supply, electrical and vacuum release switches, and electrical harness. For system operation, diagnosis and electrical schematic, refer to Section 8A-Electrical Diagnosis.

VACUUM SUPPLY

The vacuum supply to operate the Cruise Control system is routed to the servo. This is done by routing manifold vacuum to the servo through a vacuum storage tank. For vacuum routing, see Figure 9C-5. For vacuum schematic, refer to Section 8A-Electrical Diagnosis.

ELECTRICAL AND VACUUM RELEASE SWITCHES

These switches are used to disengage the Cruise Control system. An electrical release switch mounted on the brake pedal bracket (and clutch pedal bracket on vehicles equipped with manual transmission) disengages the system electrically when the brake pedal (or clutch pedal) is depressed. This is done by interrupting the flow of current to the controller. A vacuum release valve is also mounted on the brake pedal bracket. This valve vents the trapped vacuum in the servo to atmosphere when the brake pedal is depressed. This allows the servo unit to quickly return the throttle to idle position. A separate vacuum hose is routed from the servo to the normally closed vacuum switch. These two types of switches will also be combined with stop light switch, TCC switch, etc. For specific usage and adjustment of these switches, see Figure 9C-1.

ON-CAR SERVICE

SERVO LINKAGE ADJUSTMENT

See engine application Figure 9C-4.

ENGAGEMENT SWITCH

Replacement

The cruise control engagement switch is part of the multifunction lever assembly and is not serviceable by itself. The multifunction lever and switch must be replaced as an assembly.

SPEED SENSOR (PM GENERATOR)

The speed sensor is located on the left hand side of the transmission tailhousing.

CONTROLLER (MODULE)

The control module is built into the instrument cluster. If the control module is at fault, the instrument cluster must be removed.

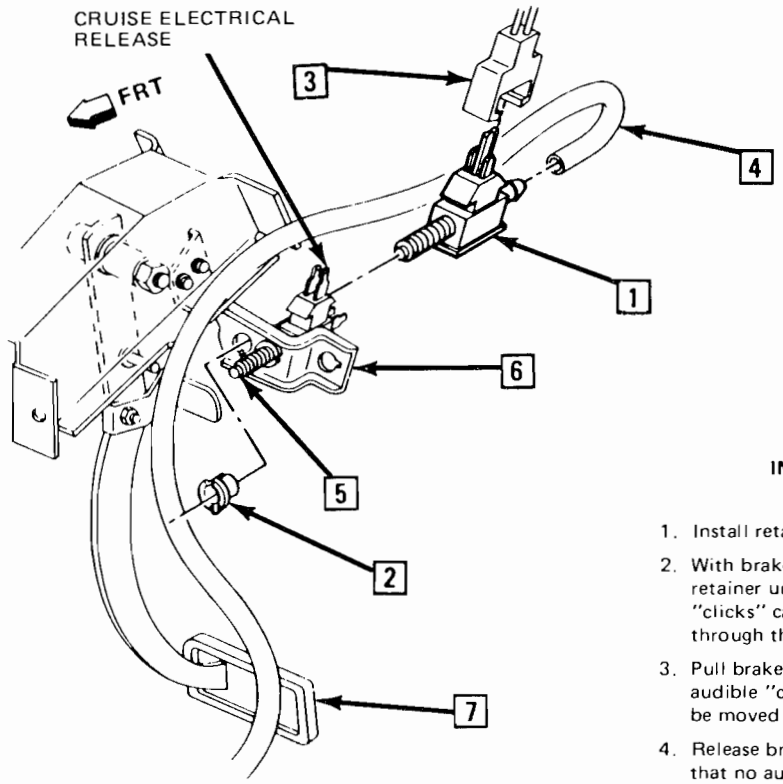
- For Removal, see Section 8C.
- For Diagnosis, see Section 8A.

RELEASE SWITCHES AND ADJUSTMENT

See Figures 9C-1 and 9C-2.

VACUUM HOSE ROUTING

See Figure 9C-5.

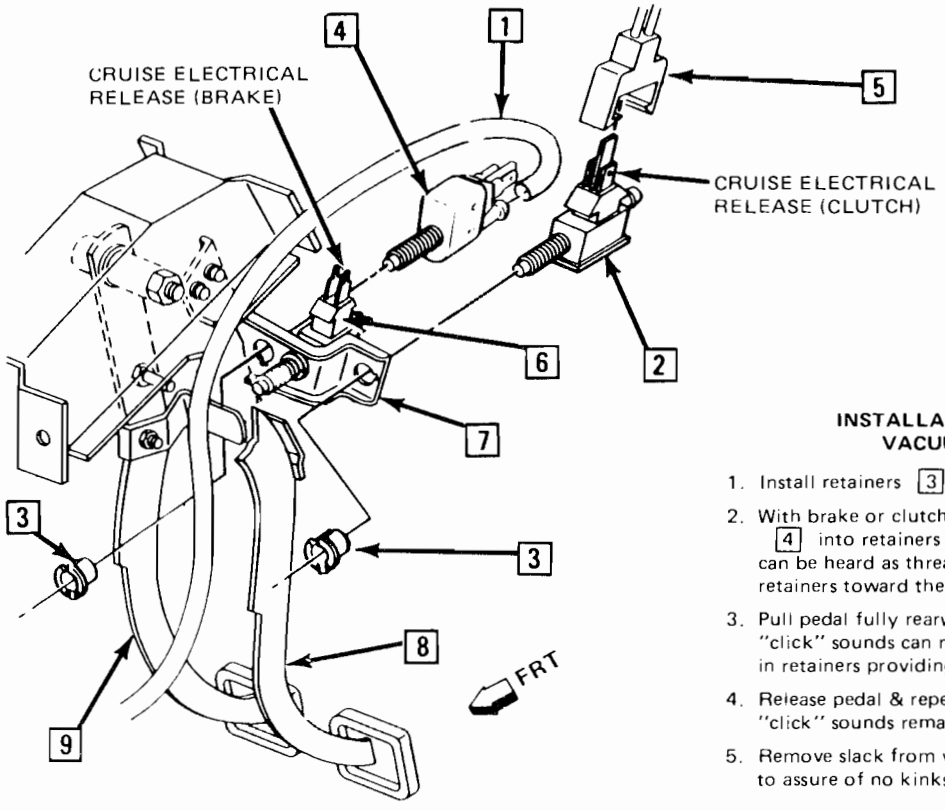


1. VALVE ASM
2. RETAINER
3. WIRING HARNESS (TCC)
4. VACUUM HOSE
5. STOP LAMP SWITCH
6. BRACKET
7. BRAKE PEDAL

INSTALLATION OF SELF-ADJUSTING VACUUM RELEASE VALVE

1. Install retainer [2]
2. With brake pedal depressed, insert valve [1] into tubular retainer until valve seats on retainer. Note that audible "clicks" can be heard as threaded portion of valve is pushed through the retainer toward the brake pedal.
3. Pull brake pedal fully rearward against pedal stop, until audible "click" sounds can no longer be heard. Valve will be moved in tubular retainer providing adjustment.
4. Release brake pedal, and then repeat step #3, to assure that no audible "click" sounds remain.

Figure 9C-1 Release Switch Location (Automatic Transmission)



1. VACUUM HOSE
2. VALVE ASM
3. RETAINER
4. VALVE ASM
5. WIRING HARNESS
6. STOP LAMP SWITCH
7. BRACKET
8. CLUTCH PEDAL
9. BRAKE PEDAL

INSTALLATION OF SELF-ADJUSTING VACUUM RELEASE VALVES

1. Install retainers [3] in direction shown.
2. With brake or clutch pedal depressed insert valves [2] & [4] into retainers until seated. Note that audible "clicks" can be heard as threaded portion is pushed through the retainers toward the pedals.
3. Pull pedal fully rearward against pedal stop until audible "click" sounds can no longer be heard. Valves will be moved in retainers providing adjustment.
4. Release pedal & repeat step #3 to assure that no audible "click" sounds remain.
5. Remove slack from vacuum hose where it comes from dash to assure of no kinks when assembly is complete.

Figure 9C-2 Release Switch Location (Manual Transmission)

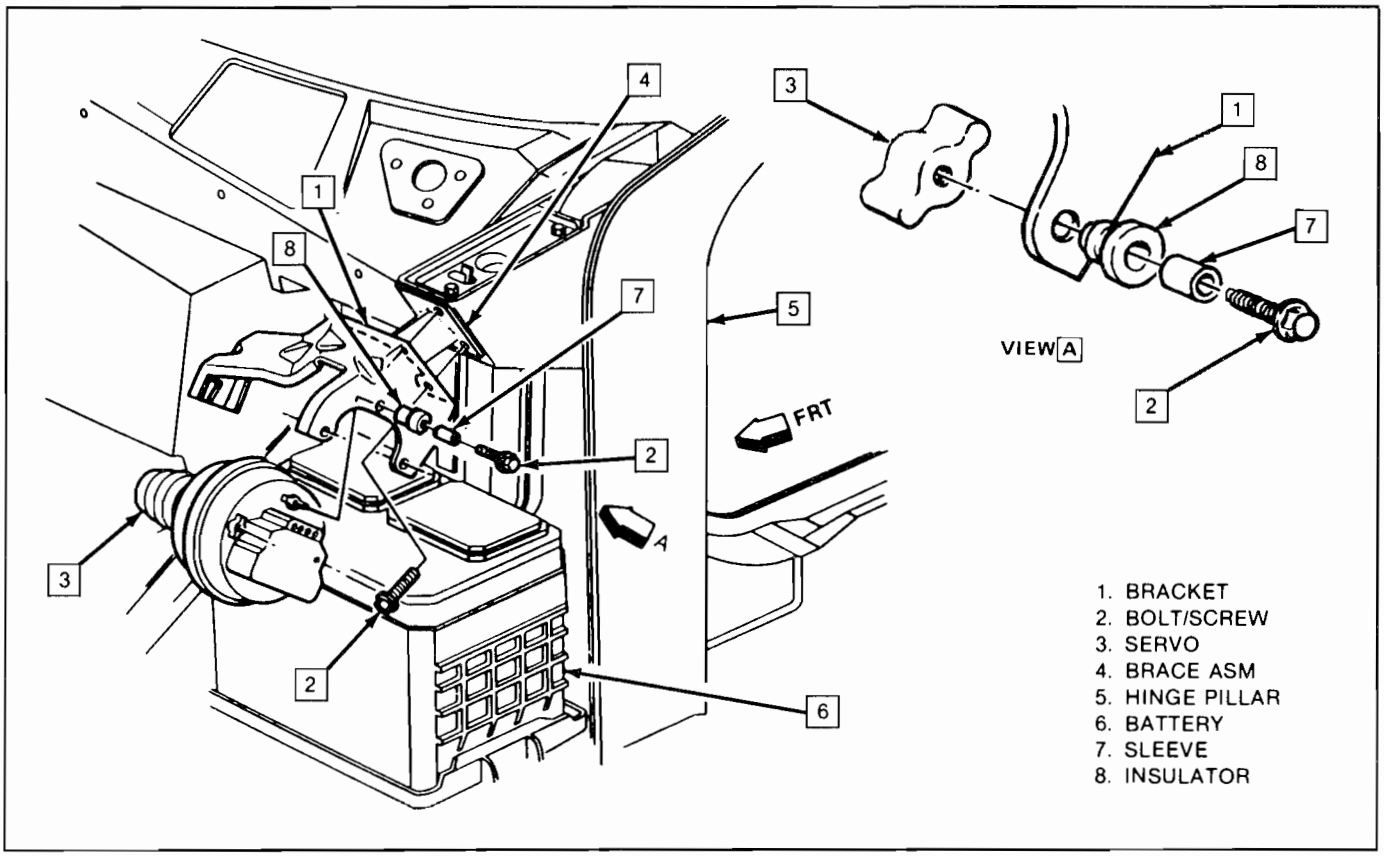


Figure 9C-3 Servo Mounting

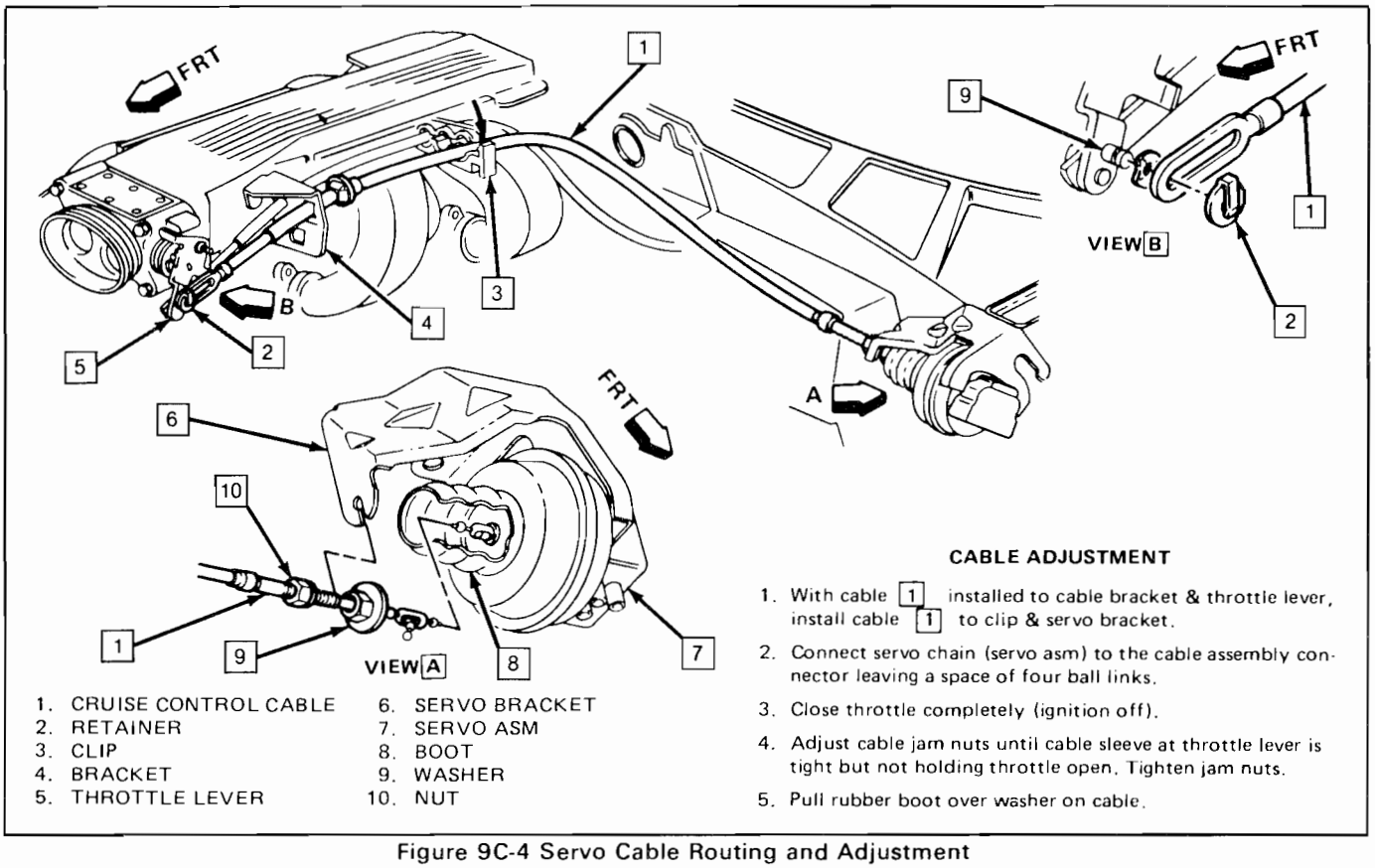


Figure 9C-4 Servo Cable Routing and Adjustment

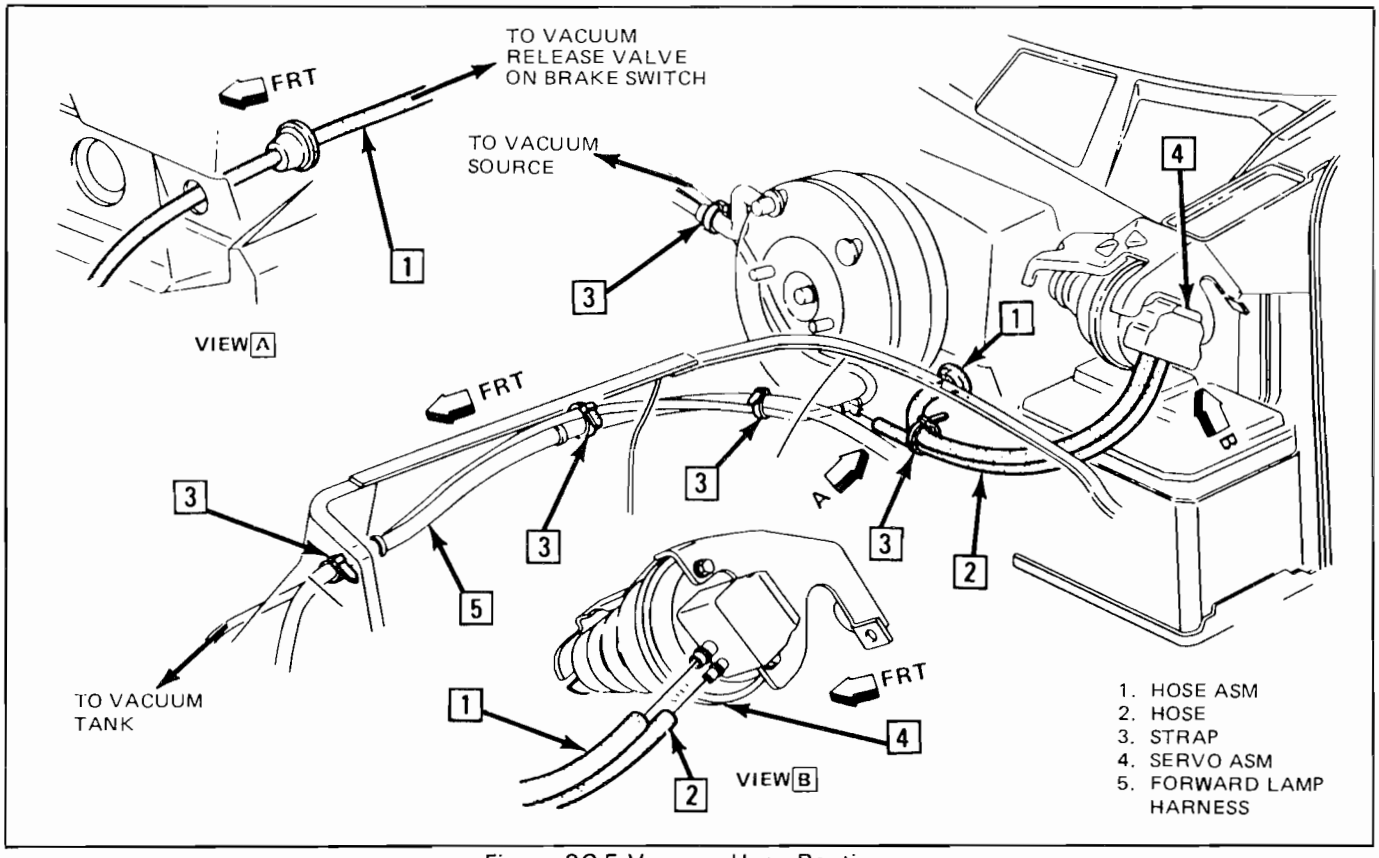


Figure 9C-5 Vacuum Hose Routing

SECTION 10

CORVETTE BODY

NOTICE: Fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts. For prevailing torque nut(s) and bolt(s), refer to the "Reuse of Prevailing Torque Nut(s) and Bolt(s)" charts in Section 0A.

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GENERAL DESCRIPTION

The Corvette body consists of an integral uniframe of galvinized steel that forms a unitized structure which is lighter and stiffer in beaming and torsional rigidity. An aluminum rear frame extension assembly is bolted onto this assembly. Dash, plenum, front and rear underbody panels, door sealing panel and roof and quarter panel are adhesively bonded to the uniframe. Front end panels, wheelhouses and front and rear bumper fascias are bolted on for improved panel fit and repairability. The removable roof panel is attached at all four corners to maximize its structural contribution.

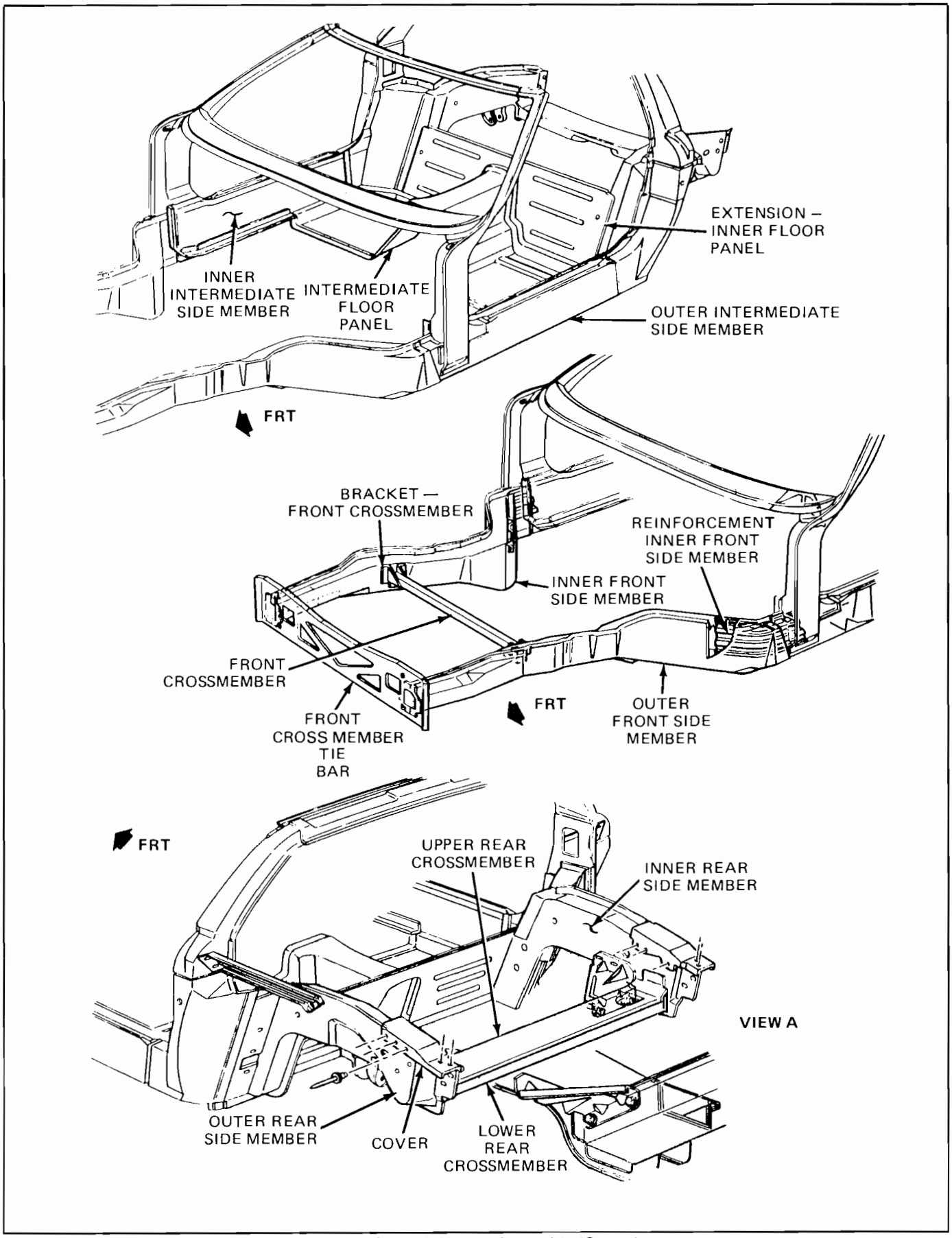


Figure 10-1A Uniframe Assembly (Coupe)

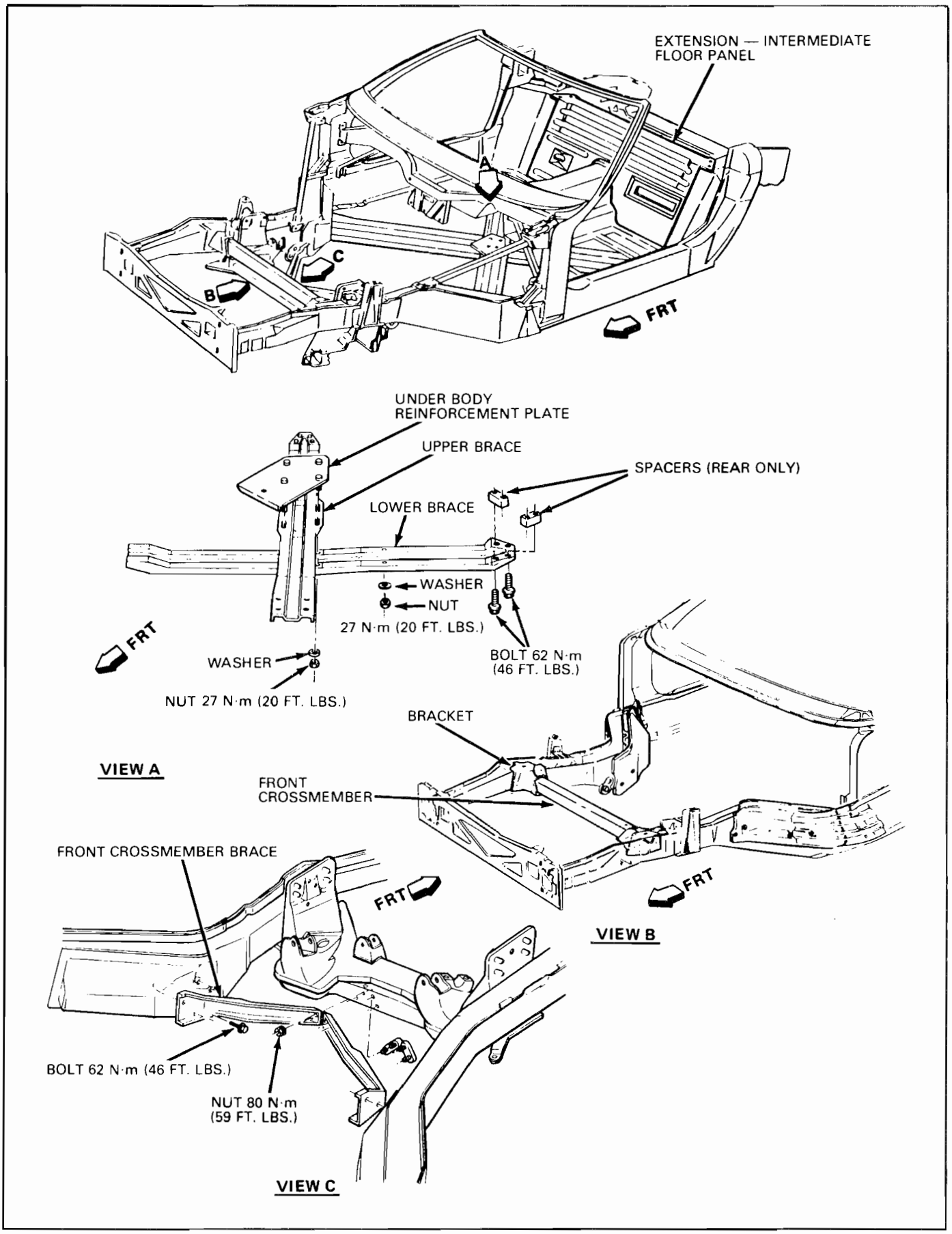


Figure 10-1B Uniframe Assembly (Convertible)

UNIFRAME SERVICE OPERATIONS

The serviceable members of the uniframe assembly include the front, intermediate and rear frame side rails; also, the uniframe has a welded center roof bow assembly. These components, with the exception of the intermediate frame side rail, which is made of mild steel, are made from high strength, low alloy steel (HSLA) and must be repaired or replaced by specific methods in the event of collision damage.

See Parts Catalog for further service part information.

This type of body construction requires that uniframe components be aligned properly to assure correct suspension location and underbody dimensions. Since each individual uniframe component contributes directly to the structural integrity of the body, it is essential that proper welding, sealing and rustproofing techniques be observed when performing service operations. When replacing uniframe members, the following precautions must be observed:

1. Members (components) are replaced at production weld joints only.
2. Drill or chisel weld joint -- never apply heat to break weld.
3. Install new parts using a Mig welder with E70S6 or equivalent wire.
4. Never cut or splice components of the uniframe.
5. Remove all flammable materials from vehicle and work area.

NOTICE: Uniframe members may be straightened cold or by applying heat to member to the point of not causing metal discoloration, otherwise component must be replaced.

There are many tools that may be used to correct collision damage situations, including bench systems and external pulling equipment. Underbody components should be rustproofed whenever body repair operations that destroy or damage the original rustproofing, are completed. Refer to Figures 10-2, 10-3A and 10-3B for unibody alignment dimensions.

When rustproofing critical underbody components, it is essential that a good quality type of air dry primer (such as corrosion resistant chromate or equivalent material) be applied first.

Front Uniframe Side Rail Extension

Removal

1. Remove all cosmetic parts of vehicle that obstruct access to rail.
2. Remove all mechanical parts of vehicle that obstruct access to rail.
3. **From inside vehicle,** remove seat and floor carpet, instrument panel support brace, and other parts that may be obstructing access to inner front rail spot welds.
4. Also, cut insulating material from kick-up to kick pad with razor to gain access to spot welds.
5. Clean seam sealer to further identify welds at front door hinge pillar.
6. Remove 7mm holding screws from floor pan support bracket.
7. Drill out spot welds (approx. 5) retaining bracket to inner front rail member.
8. **Working outside of vehicle** , remove Mig welds attaching gusset to hinge pillar and front rail extension. Right side only, cutaway portion of blower motor housing to gain access to gusset welds.
9. Remove brace from hood primary latch to front rail extension.
10. Drill through spot welds (at outer face) attaching front rail extension to intermediate side rail (approx. 9, with one inch overlap).
11. **Working underneath vehicle,** place gas or brake lines away from work area.
12. Locate spot welds at lower rocker flange, drill through to intermediate rail and floor pan support bracket.
13. Cut floor pan bracket at bottom so that bracket may be removed without breaking rear spot welds.

NOTICE: This step may require an air chisel as the adhesive bonding bracket to floor pan may be difficult to remove.

14. **Working inside of vehicle,** with bracket removed, identify spot welds attaching front extension rail to intermediate side rail.
15. Drill out spot welds in this area.
16. **Working outside of vehicle,** drill out spot welds attaching front crossmember tie bar to front side rail extension.
17. Using appropriate tools, remove Mig welds, attaching front crossmember to front side rail extension.
18. Making sure all welds are disengaged, remove front side rail extension from vehicle. Since rear of extension is boxed around intermediate side rail, it may require some force to remove from vehicle.

NOTICE: When drilling out spot welds, first drill a starter hole then drill out to size of spot weld.

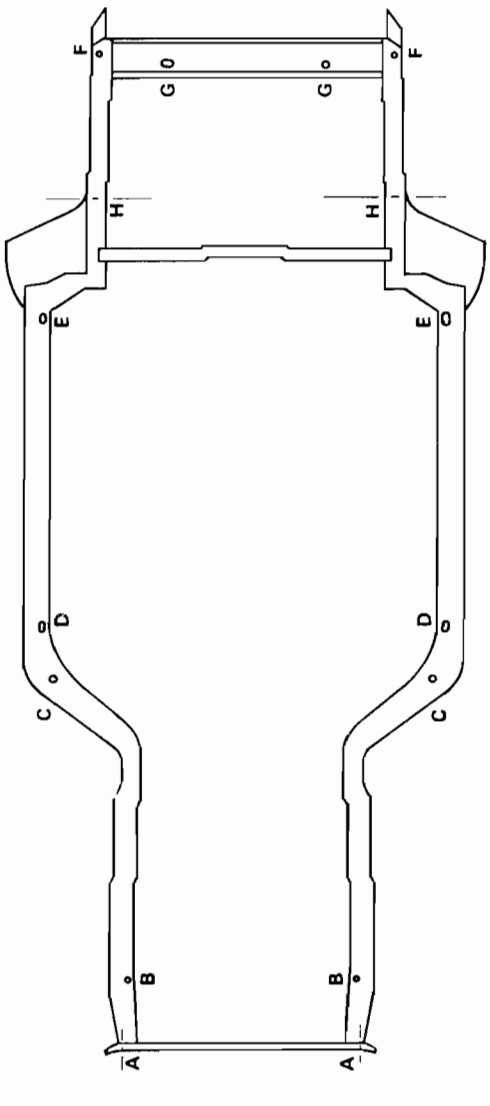
Installation

1. Clean up welds and grind off burrs.
2. Install replacement front side rail extension and lock in place with vise grips, "C" clamps or self-tapping screws.
3. Before starting welding operations, cover body areas with fire resistant fabric to avoid weld gun splatter.
4. Follow weld pattern shown on Figure 10-4.

Uniframe Intermediate Side Rail (Rocker Panel)

Removal

Follow Steps 1-15 of "Front Side Member Extension".



STRAIGHT LINE (Front to Rear)	
A to F	3551 mm
A to D	1514 mm
A to G	3421 mm
B to C	1081 mm
B to D	1262 mm
B to G	2151 mm
D to E	1068 mm
E to F	919 mm

CRISS CROSS (Side to Side)	
A to F	3648 mm
A to G	3479 mm
B to C	1472 mm
B to D	1631 mm
E to F	1486 mm
D to E	1735 mm
B to G	2315 mm

STRAIGHT LINE (Side to Side)	
A to A	680 mm
D to D	1367 mm
F to F	991 mm
B to B	774 mm
C to C	1300 mm
E to E	1367 mm

DATUM HEIGHT	
A	350 mm
B	367 mm
C	177 mm
D	186 mm
E	186 mm
F	386 mm
G	392 mm
H	559 mm

FRAME LENGTH	
A to B	
B to C	692.5 mm
C to D	537.5 mm
D to E	1068 mm
E to F	925 mm

DESCRIPTION OF POINTS

A Slot in front facia (subtract 30mm for tramming from lower front edge)

B Bolt hole used for skid bracket attachment. In bottom of rail, remove splash shields for access.

C Gauge hole (15mm) bottom side of rail forward of hinge pillar

D & E Rocker panel front attaching slot, remove rocker panel for access.

F Welded nut in hole bottom of rear rail pocket, near rail drain hole

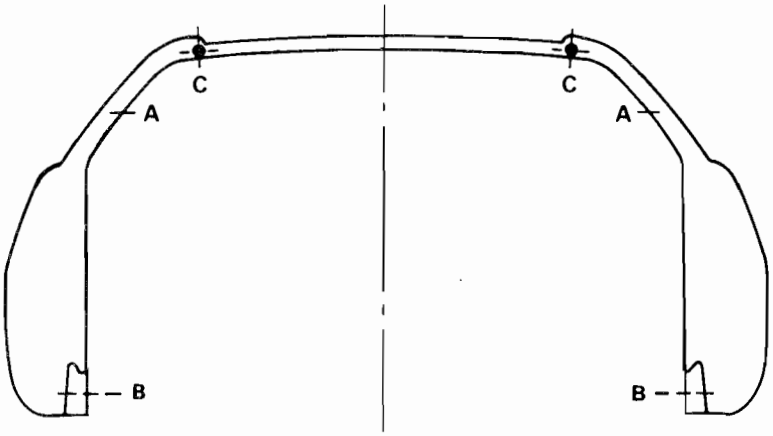
G Slot and hole in bottom of rear cross member

H Gauge hole (16mm) side of rear rail above shock mounting bracket (remove plug to measure)

NOTE: Dimensions are trammed from centerline to centerline unless stated otherwise.

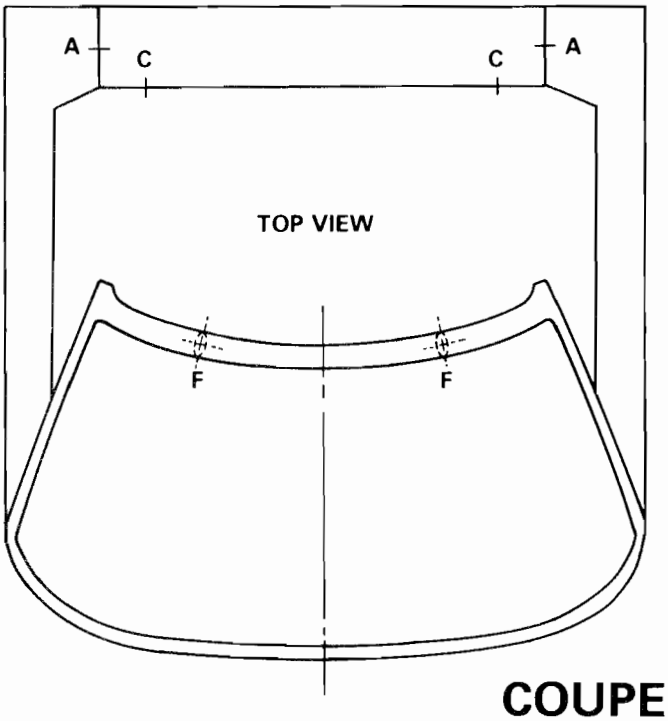
Figure 10-2 Horizontal and Vertical Dimensions (Coupe/Convertible)

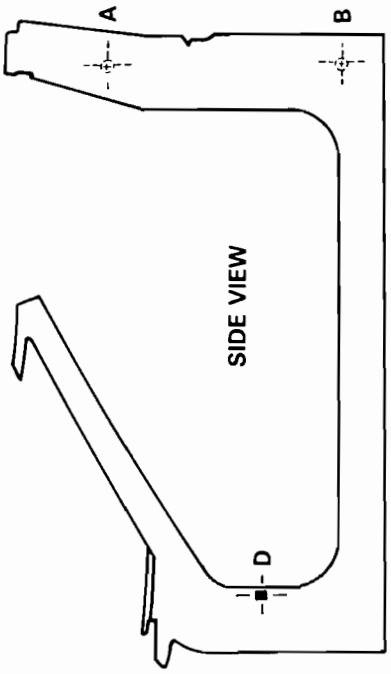
FRONT VIEW OF REAR PILLAR



DESCRIPTION OF HOLES
— COUPE —

A — Shoulder harness attachment hole
B — Seatbelt attachment hole
C — Oblong holes used to hold roof panel attachment brackets in place, the two outside holes
D — Square hole on inside pillar
F — Oblong holes on the underside of windshield frame





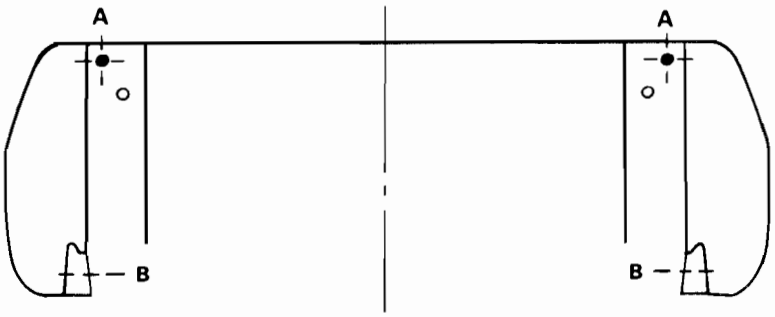
COUPE

SIDE TO SIDE		FRONT TO REAR		CRISS CROSS		TOP TO BOTTOM	
A TO A	1320 mm	**A TO F**	802 mm	**A TO B**	1515 mm	**A TO B**	725 mm
B TO B	1338 mm	**C TO F**	709 mm	**B TO C**	1435 mm		
C TO C	870 mm	**A TO D**	1305 mm				
D TO D	1402 mm	**B TO D**	1035 mm				
F TO F	583 mm						

NOTE: All measurements are to be taken from center to center of reference points. This can be accomplished by tape measure or tram with equal datum heights.

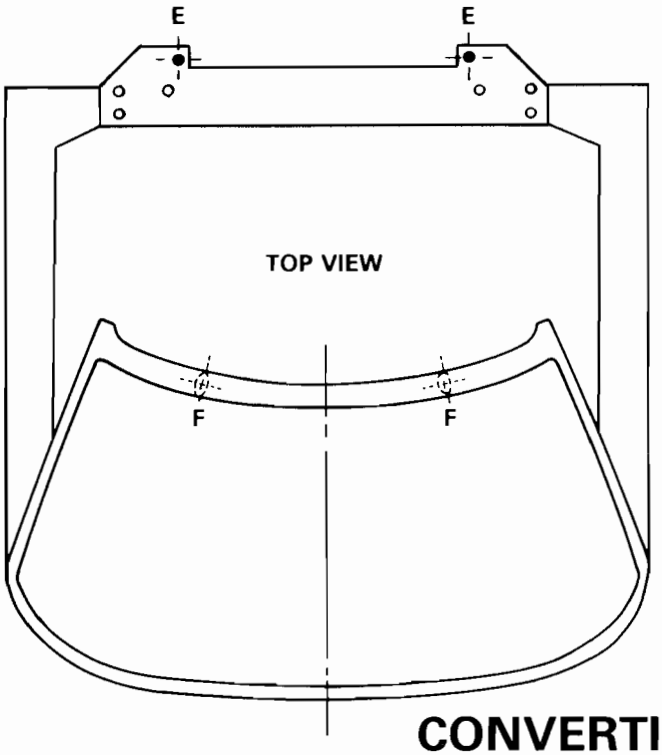
Figure 10-3A Uniframe Upper Dimensions (Coupe)

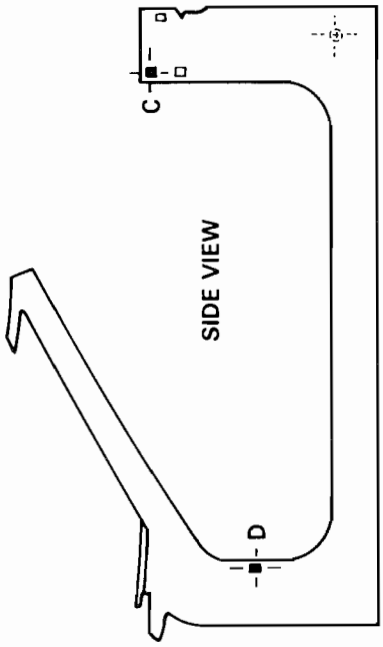
FRONT VIEW OF REAR PILLAR



DESCRIPTION OF HOLES
— CONVERTIBLE —

- **A** — Extreme upper shoulder harness attachment hole
- **B** — Seat belt attachment hole
- **C** — Convertible top attachment hole
- **D** — Square hole on inside pillar
- **E** — Top of front rear rail shoulder harness attachment hole
- **F** — Oblong holes on the underside of windshield frame





CONVERTIBLE

SIDE TO SIDE		FRONT TO REAR		CRISS CROSS		TOP TO BOTTOM	
A TO A	1238 mm	B TO D	1035 mm	B TO D	1720 mm	A TO B	423 mm
B TO B	1338 mm	C TO D	1174 mm	C TO D	1825 mm		
C TO C	1398 mm			C TO F	1210 mm		
D TO D	1402 mm			E TO F	1203 mm		
E TO E	982 mm						
F TO F	583 mm						

NOTE: All measurements are to be taken from center to center of reference points. This can be accomplished by tape measure or tram with equal datum heights.

Figure 10-3B Uniframe Upper Dimensions (Convertible)

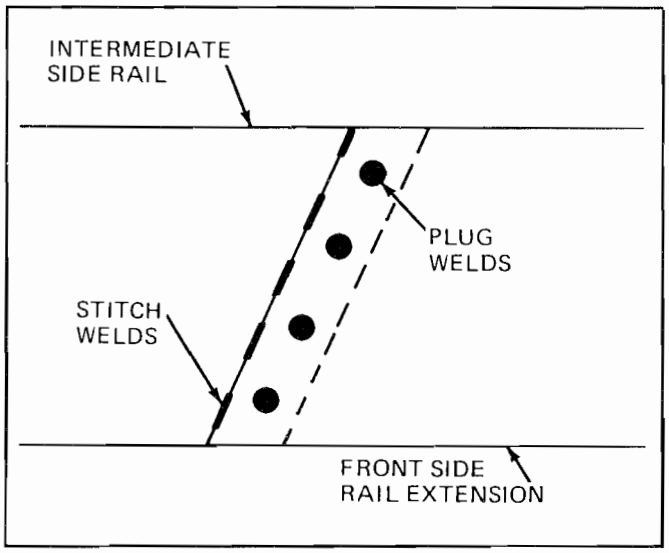


Figure 10-4 Weld Pattern

16. Drill out spot welds attaching bottom edge of intermediate side rail to floor pan support.
17. Using a spot weld drill, remove outer lock pillar panel by drilling out all spot welds attaching panel to rocker panel facing, inner lock pillar, around door jamb to rear side rail extension, and lower flange.
18. After outer lock pillar panel is removed, identify spot welds to rocker panel and to inner lock pillar. From outside of vehicle, drill out spot welds attaching these panels.
19. **From outside vehicle,** drill out spot welds attaching intermediate side rail to outer hinge pillar.
20. Making sure all welds are disengaged, remove intermediate side rail (rocker panel) from vehicle.

Installation

Reverse removal procedure.

Uniframe Rear Side Frame Rail Extension

Removal

1. Remove seat assembly, floor carpeting, trim parts, and mechanical parts to gain access to rear side frame rail.
2. Drill out rivets retaining close out panel and remove from vehicle.
3. From inside of vehicle, clean up sealer from floor pan to top of rail to identify spot welds. Cut away vertical portion of fiberglass floor pan to gain access to lock pillar.
4. Drill out spot welds (through). Drill 3/4" access hole to gain access to inner floor panel reinforcement and to rear rail extension spot weld.
5. If necessary, make cutout (14" x 5" at 3" from rear of panel) to gain access to upper spot welds attaching rear crossmember and gusset.

NOTICE: If necessary, gussett can be removed after rear side rail has been removed from vehicle.

6. **From side of vehicle,** break loose welds attaching outer rear side rail brace to rear rail extension (wheel well area).
7. Drill out outer lock pillar panel spot welds in wheel well area.
8. From underneath vehicle, drill out spot welds retaining lock pillar cap (four sides) and remove.
9. Drill out remaining spot welds retaining rear side rail extension to rear crossmember.
10. Remove bolts retaining rear side rail extension gusset to rear crossmember, making sure all welds are disengaged. Remove rear side rail extension from vehicle.
11. Remove anti-squeak cap from rail.

Installation

Reverse removal procedure.

LOCK CYLINDER CODING

KEY IDENTIFICATION AND USAGE

The lock cylinder keyway is designed so that other model keys will not enter a current model lock cylinder. Two noninterchangeable keys are used. One key, identified by a square head, is used in the ignition lock cylinder. The second key, identified by an oval head, is used in doors and rear storage compartment lock cylinders. The square ignition key will not fit into the door lock cylinder and the oval key wll not fit into the ignition lock cylinder.

Key identification is obtained from the four character key code stamped on the knockout portion of the key head and an identification letter stamped on the key shank. After code number has been recorded, plugs should be knocked out of key head. From these numbers, lock combinations can be determined by use of a code list (available to owners of key cutting equipment from equipment suppliers). If key code numbers are not available from records or from the knockout plug, lock combinations (tumbler numbers and position arrangement) can be determined by laying key on the diagram in Figure 10-5.

NOTICE: The mechanical code for the ignition lock cylinder (square key) must be cut on a special key blank designed for use in the Vehicle Anti-Theft System (VATS).

If all 3 VATS ignition keys are lost or the ignition lock cylinder or VATS decoder module are replaced, all 3 VATS ignition keys should be replaced.

Refer to Section 8A for Electrical Diagnosis.

CUTTING KEYS

After the code has been determined from the code list or the key code diagram (Figure 10-5), cut blank key to the proper level of each of the six tumbler positions, and check key operation in lock cylinder.

REPLACEMENT LOCK CYLINDERS

Doors and Rear Storage Compartment

New lock cylinders, other than ignition lock cylinders, are available from the service parts warehouse with new lock cylinder locking bar. Tumblers are also available and must be assembled into cylinder as outlined below.

ASSEMBLING AND CODING LOCK CYLINDERS

All Lock Cylinders Except Rear Storage Compartment

Tumblers for all locks, except ignition lock and rear storage compartment, are shaped exactly alike with the exception of a notched position on one side. As key is inserted in lock cylinder, tumblers are lowered to correct height so that notches on each tumbler are at the same level. When the notches on all six tumblers line up, the side bar is pushed into the notches by two small springs; thus allowing cylinder to turn in its bore. Five types of tumblers are used to make various lock tumbler combinations and each is coded according to a number 1 through 5, stamped on its side.

1. Find lock cylinder tumbler numbers and tumbler arrangement by use of numerical key code lock cylinder code list. Code lists are made available to owners of key cutting equipment by equipment suppliers. If code list is not available, proceed as follows:
   a. Lay key on key code diagram (Figure 10-5) with key outlined by diagram.
   b. Starting at head of key blade, find and record lowest level (tumbler number) that is visible in position number 1 and subsequent position numbers 2 through 6. After tumbler numbers and arrangement have been determined, assemble as follows:
2. Starting at open end (head) of cylinder, insert tumblers in their proper slots in the order called by the code (Figure 10-6).
3. Pull out side bar with fingers so that tumblers will drop completely into place (Figure 10-6).

NOTICE: If the springs become tangled, do not pull them apart, unscrew them or they may be damaged. Insert one tumbler spring in space provided above each tumbler.

4. Insert spring retainer so the two end prongs slide into the slots at either end of cylinder. Press retainer down (Figure 10-7). If tumblers have not been assembled correctly, they can be removed from cylinder by holding cylinder with tumbler slots down, pulling side bar out with fingers and jarring cylinder to shake tumblers out. This procedure is necessary because once the tumblers have been pressed down into the cylinder they are held in their slots by the side bar.
5. To check if tumblers have been installed properly; insert key into lock cylinder. If tumblers are installed properly, the side bar will drop down. If bar does not drop down, remove key, spring retainer, springs and tumblers and reassemble correctly.

NOTICE: Use leather or wood at each vise jaw to prevent damage to cylinder.

6. If lock cylinder is assembled properly, remove key and secure cylinder in a vise with spring retainer exposed.
7. Using suitable staking tool, stake spring retainer securely in place by staking cylinder metal over retainer at each end (Figure 10-7).
8. Lubricate cylinder with WD-40, 3M 4-way No. 8902 or equivalent spray lubricant.

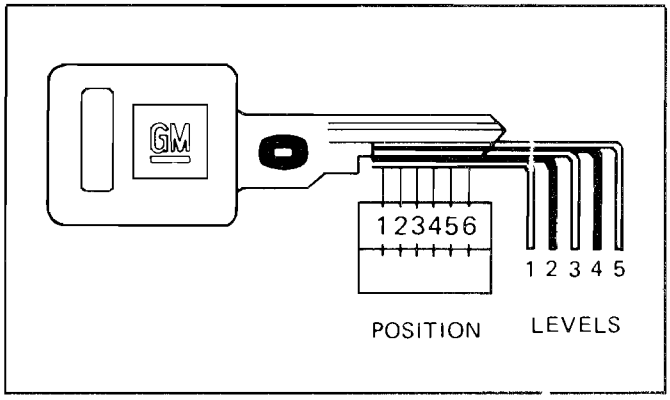


Figure 10-5 Key Code Diagram

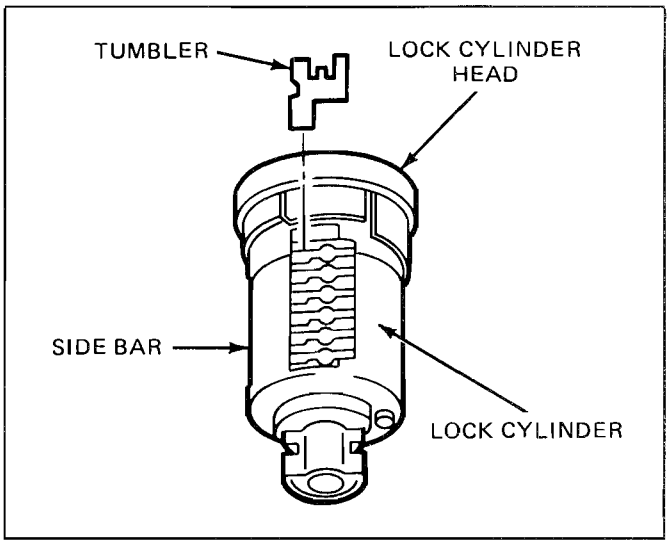


Figure 10-6 Installing Tumblers

Rear Storage Compartment Lock Cylinder (Coupe Only)

All styles use a lock cylinder with snap-in tumblers for the rear storage compartment lock. These lock cylinders have five positions and four tumblers. The number 1 position (closest to cylinder head) is a brass retainer tumbler. The Number 2 through Number 5 positions are standard tumbler positions.

The snap-on type cylinder is used only for the rear storage compartment. Therefore, lock cylinder components, including cylinders, tumblers, retainer tumblers and tumbler springs are not interchangeable

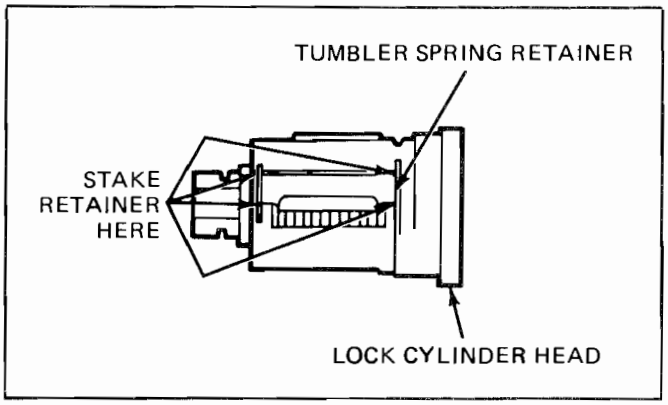


Figure 10-7 Installing Spring Retainer

for any other lock cylinder application. Individual components for servicing the snap-in cylinder are available through the service parts system.

1. Find lock cylinder tumbler numbers and tumbler arrangement by use of numerical key code lock cylinder code list. Code lists are made available to owners of key cutting equipment by equipment suppliers. If code list is not available,proceed as follows:
   a. Lay key on key code diagram (Figure 10-5) with key outlined by diagram.
   b. Starting at head of key blade, find and record lowest level (tumbler number) that is visible in position number 1 and subsequent position numbers 2 through 5. After tumbler numbers and arrangements have been determined, assemble as follows:
2. Starting at open end (head) of cylinder, insert tumbler spring and retainer tumbler in first position, then proceed to insert tumbler springs and tumblers in their proper slots in the order determined by code, as shown in Figure 10-8.
3. Place cylinder in vise, tumblers up, using leather or wood at each vise jaw to prevent damage to cylinder.
4. Place small wooden block flat on exposed tumblers and tap tumblers down flush with cylinder as shown in Figure 10-9.
5. Lubricate cylinder with WD-40, 3M 4-way No. 8902 or equivalent spray lubricant.

LUBRICATION

Mechanical parts having contacting surfaces in relative motion with other body parts are lubricated during assembly. To maintain ease of operation, it is recommended that these parts be lubricated at the basic service interval shown in the Maintenance Schedule as follows:

1. All door hinges are to be lubricated with engine oil (30 weight preferred). Apply lubricant to roller and hinge pin bushings but do not lubricate hold-open link and roller contacting surfaces as this may cause improper roller operation.
2. All locks and compartment lid hinges are to be lubricated with Part No. 1052196, Lubriplate Auto-Lube A., Part No. 1052349, Lubriplate Spray-Lube A, 3M Lithium Spray Lube No. 8915 or equivalent.

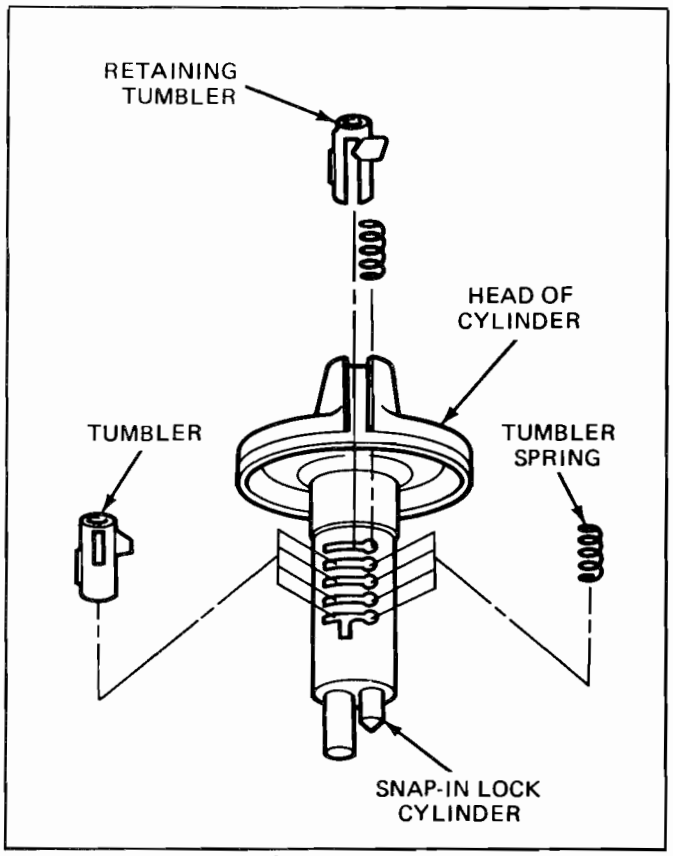


Figure 10-8 Installing Tumblers

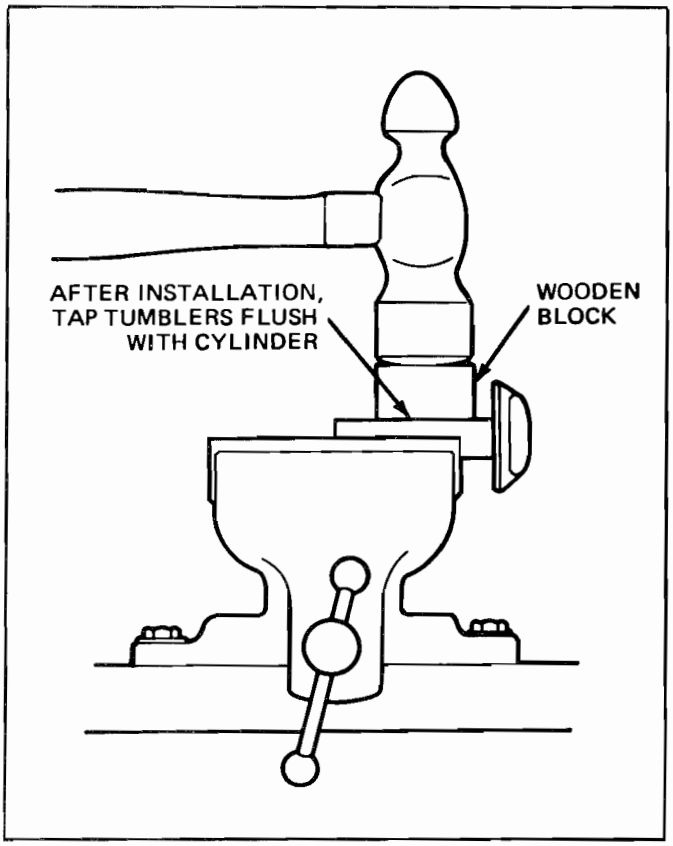


Figure 10-9 Locking Tumblers in Place

3. Lubricate lock cylinders with WD-40, 3M 4-way No. 8902 or equivalent spray lubricant.

ON-VEHICLE SERVICE

HOOD ADJUSTMENTS (FIGURE 10-10)

Hood adjustments should be made in the following order:

1. Loosen and tighten hood hinge nuts to align hood laterally.
2. Loosen and tighten hood hinge frame bolts for fore and aft adjustment.
3. Loosen and tighten either the lock and bolt assemblies or latch assembly for lateral alignment at rear of hood.

HOOD HINGE

Removal

1. Raise hood and support. Disconnect battery ground cable.
2. Remove hood assist rod.
3. Remove hood hinge upper bracket.
4. Remove hinge to frame bracket bolts (2).
5. Remove hood hinge to frame bolts (3).
6. Remove upper hood hinge nuts and remove hinge from vehicle.

Installation

Reverse removal procedure and align hood as necessary.

HOOD PRIMARY LATCH ASSEMBLY

Removal

1. Raise hood. Disconnect battery ground cable.
2. Remove cowl seal from latch.
3. Remove release cable.
4. Scribe latch location and remove from vehicle.

Installation

Reverse removal procedure, align as necessary, and re-glue seal.

HOOD RELEASE CABLES

Installation of the hood release cables are illustrated in Figure 10-11. Synchronization of latch release may be made by adjusting the cable retainer located at left hand latch assembly.

HOOD ASSEMBLY (FIGURE 10-10)

Removal

1. Raise hood.
2. Disconnect battery ground cable.
3. Remove right and left upper wheel house at hood panel (eight screws each side).
4. Remove two underhood lamps.
5. Remove bolt and spring assemblies (right and left) retained by (3) bolts each side.
6. Disconnect headlamp wire connectors and remove lamps from vehicle. See Section 8B.
7. Remove hood emblem (2 nuts).
8. Remove remaining fasteners and clips.
9. Remove hood support rod.
10. Scribe location of hinge to hood and with aid of helper, remove hinge to hood nuts (2 each side) and remove hood from vehicle. If hinges are removed, note number of shims used on each hinge.

Installation

When replacing original hood, align hinge with scribe marks made on removal and install hinge to hood retaining nuts.

Reverse removal procedure for balance of installation. Align hood as necessary.

FRONT FENDER (FIGURE 10-12)

Replace

1. Raise and support hood.
2. Disconnect negative battery cable.
3. Remove fender to splash shield attaching screws (3).
4. Remove rear fender to brace retaining screws (2) and fender seal.
5. Remove clips, moldings and fender brace.

Installation

To install, reverse the removal procedure.

OUTSIDE REAR VIEW MIRROR (FIGURE 10-13)

Removal

1. Roll window down, remove door trim panel and water deflector.
2. Disconnect battery ground cable.
3. Remove clips retaining wiring to door panel.
4. Remove 2 attaching nuts and remove mirror assembly from vehicle.

Installation

To replace mirror, reverse removal procedure.

INSIDE REAR VIEW MIRROR

Removal - Figure 10-14

1. **Coupe** - Remove roof panel.
   Convertible - Fold top into stowage area.
2. Remove windshield garnish molding screws.
3. Remove mirror attaching screw.

4. Disconnect electrical connector from behind garnish molding.
5. Remove mirror.

Installation

Reverse removal procedure.

Bulb Replacement

1. Pry light assembly from the mirror at the slots provided on the outer ends of light lens.
2. Remove clip holding connector.
3. Replace bulb.

SUNSHADE (FIGURE 10-15)

Removal

1. **Coupe** - Remove roof panel.
   Convertible - Fold top into stowage area.
2. Remove latch cover.
3. Remove retainer and spring.
4. Remove sunshade.
   - On passenger side, it will be necessary to remove the garnish molding to access and disconnect wiring for the vanity mirror.

Installation

Reverse removal procedure for installation.

WINDSHIELD

Windshield installation requires the use of a self-curing urethane adhesive that adheres to both the glass and the pinchweld frame. Applied to the glass while in a soft state, the material begins to cure soon after exposure to air and humidity. It is therefore essential that installation of the glass quickly follow application of material. The components of glass adhesive kit (urethane) No. 9636067 or equivalent are as follows:

1. One tube of urethane adhesive material.
2. One dispensing nozzel.
3. Steel Music Wire (.020" diameter).
4. Primers.
5. Primer applicator.

Additional materials required:

1. Solvent for cleaning edge of glass (preferrably alcohol).
2. Adhesive dispensing gun J-24811 or a standard household cartridge type gun reworked as follows:
   a. Widen end-slot to accept dispensing end of adhesive material tube.
   b. Reduce diameter of plunger disc on rod so that disc can enter large end of adhesive material tube.
3. Commerical type razor knife (for cutting around edge of glass).
4. Cold knife J-24402-A or equivalent or two pieces of wood for wire handles.
5. Black weatherstrip adhesive.

Replacement (Figures 10-16 thru 10-18)

1. Open hood.
2. Remove windshield wiper arms.
3. Remove weatherstips (L and R) from frame by removing mounting screw, and carefully pulling away from channel.
4. Remove side retainer moldings (L and R) by removing screws to frame.
5. Remove side reveal molding (L and R) by removing one remaining screw.
6. After indexing molding and header rail with tape to insure proper reinstallation, remove upper reveal molding by carefully prying out at corner with screwdriver and then pulling out remainder by hand.
7. Secure one end of steel music wire to piece of wood for handle. Insert other end through urethane adhesive material at lower corner of windshield; then secure end of wire to another piece of wood.
8. Using cold knife J-24402-A cut through urethane adhesive material across top and down both sides of windshield. With the aid of helper, carefully cut through urethane adhesive material (using a sawing motion) with the steel wire across bottom of the windshield.
9. Remove old glass from windshield opening.
10. Using a sharp scraper or wood chisel, remove urethane adhesive material from pinchweld flange. It is not necessary clean off all the old urethane adhesive completely from windshield frame; however, there should not be any loose pieces left in the opening.
11. Using suction cup holders, position replacement glass in body opening. Carefully check relationship of glass to body pinchweld completely around opening. The overlap of glass to body pinchweld and retaining flanges should be equal with a minimum overlap of 3/16". Where necessary, position shims under the lower spacers to obtain required overlap of glass to body upper and lower flanges.
12. After proper glass to pinchweld relationship has been attained, mark position with grease pencil on glass and windshield pillar.
13. Remove glass from body opening and place on protected surface.
14. Thoroughly clean surface of glass to which bead of adhesive material will be applied (around edge of inside surface of glass) by wiping with a clean, alcohol dampened cloth. Allow to air dry.
15. Apply primer provided in Urethane Adhesive Kit No. 9636067 or equivalent as follows:

NOTICE: Both Glass Prep No. 1 (clear) and Primer No. 2 (black) must be thoroughly stirred and agitated prior to application.

   a. Apply primer to entire perimeter of glass edge and 1/4" inboard on inner surface. Allow primer to dry for 5 minutes.
   b. Apply Glass Prep No. 1 to edge and inner surface of glass. Wipe dry with a clean cloth. Apply primer No. 2 to any portion of glass opening that requires refinishing and

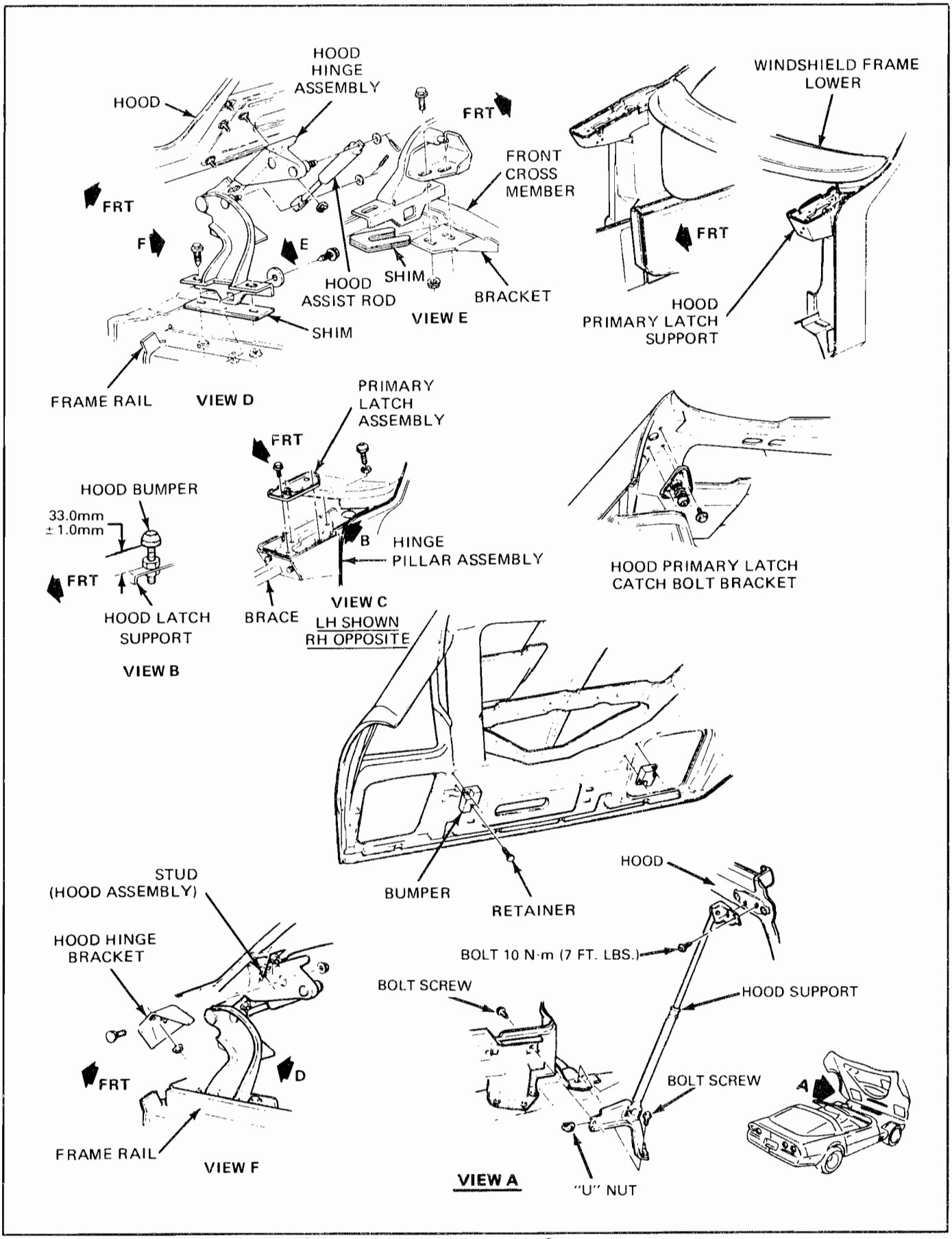


Figure 10-10 Hood Assembly Components

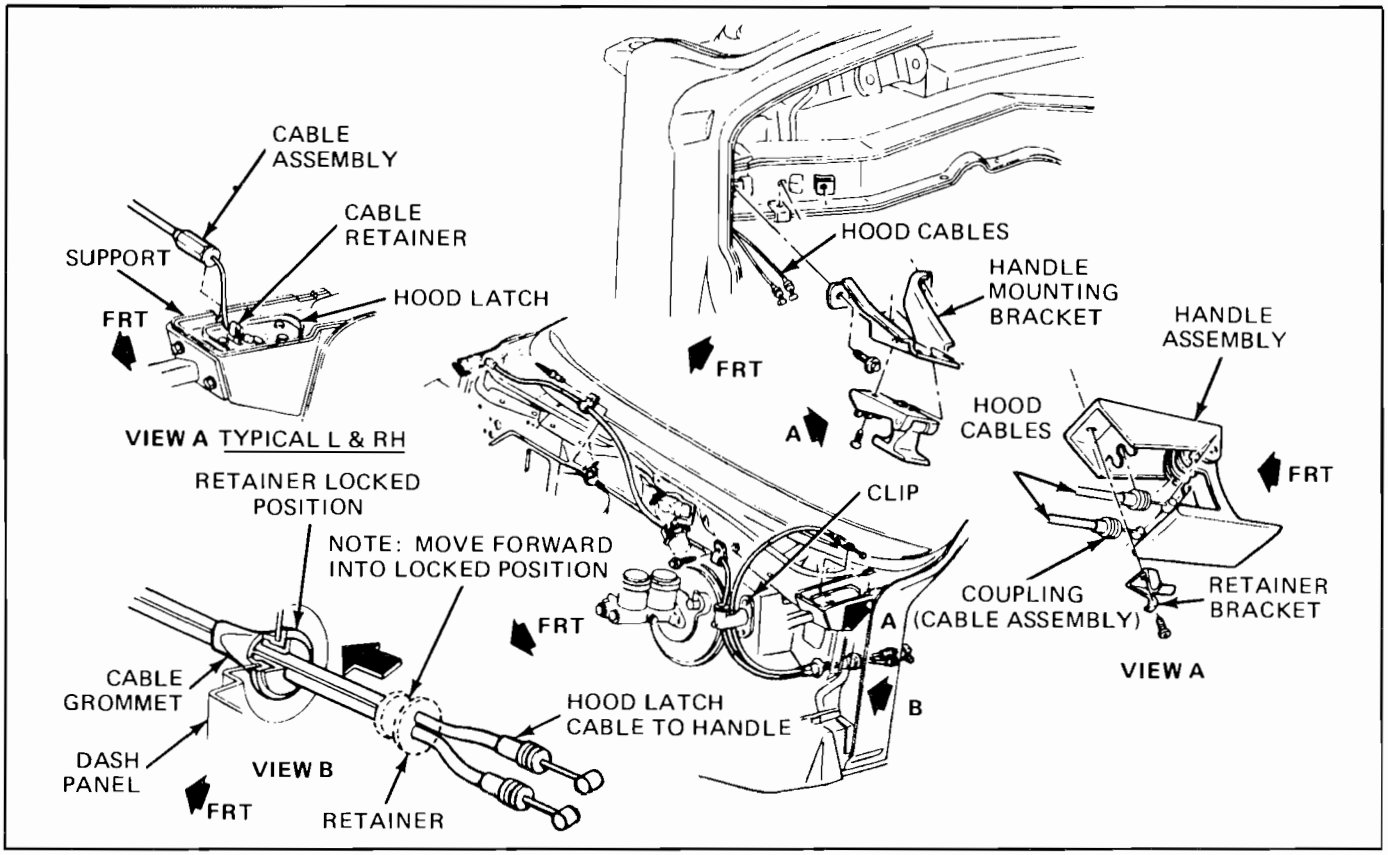


Figure 10-11 Hood Release Cables

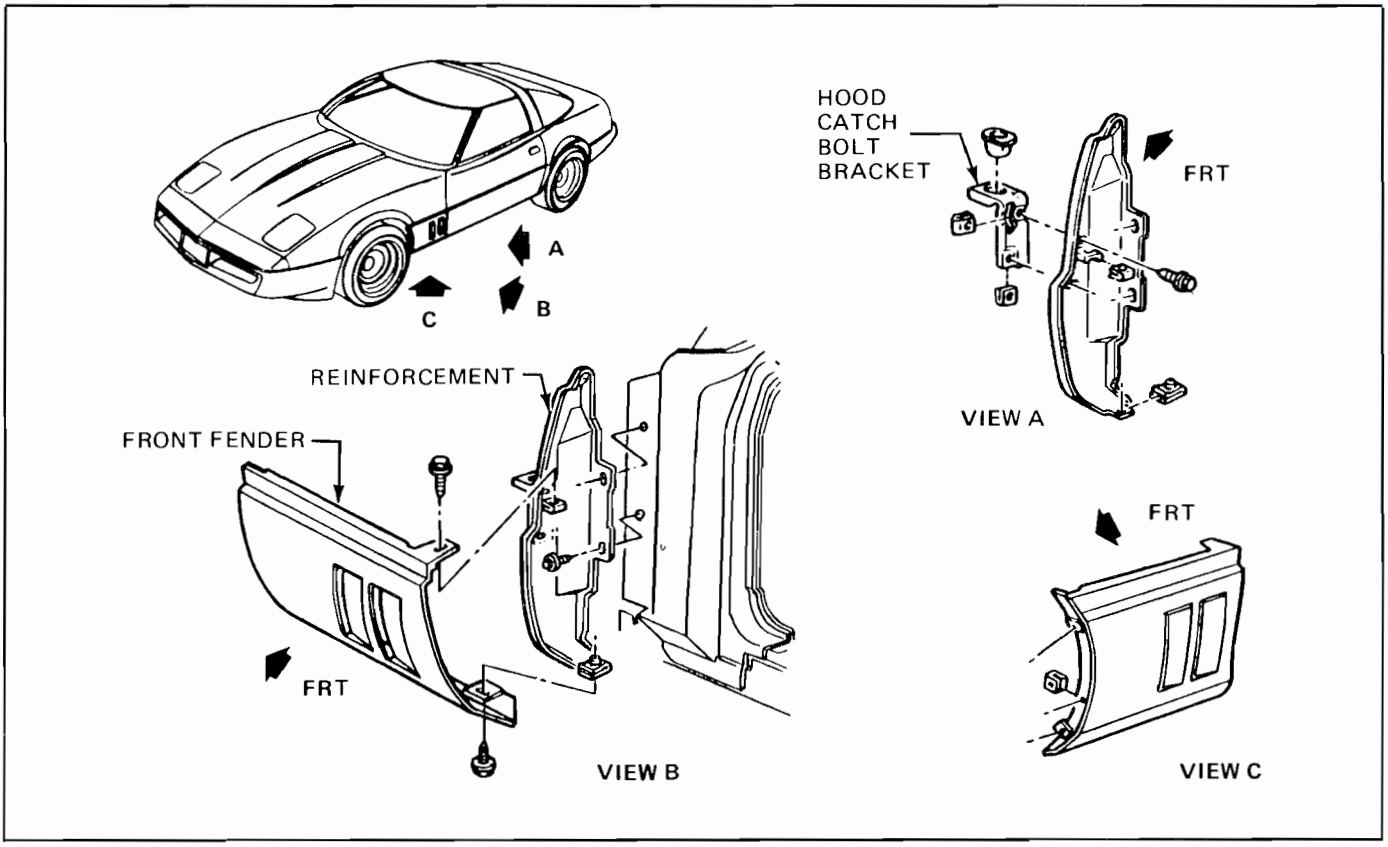


Figure 10-12 Front Fender Assembly

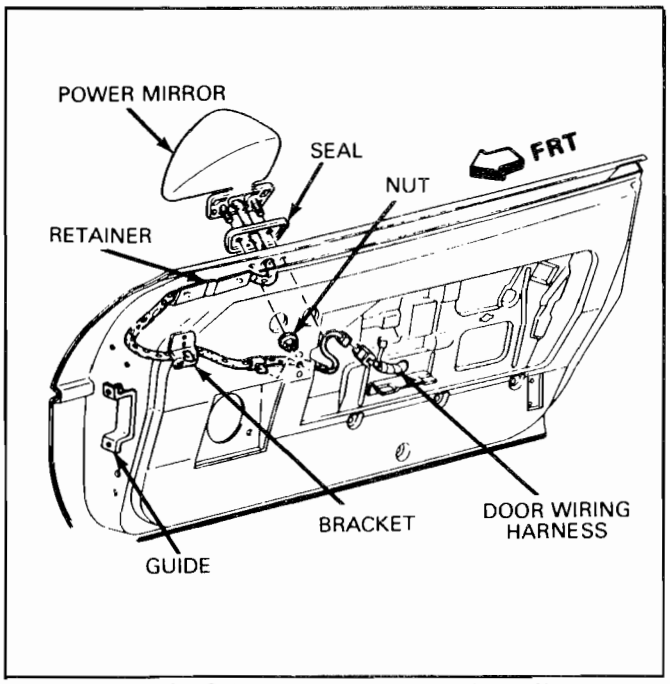


Figure 10-13 Outside Power Rearview Mirror

painting operations, or any portion that was cleaned of former adhesive sufficiently to expose the painted surface. Allow primer to dry for 5 minutes.

16. With caulking gun and nozzle positioned as illustrated in Figure 10-18, carefully apply smooth continuous bead of adhesive material 1/8" high by 3/16" wide at base completely around inside edge of glass.
17. With aid of helper, carefully position glass in windshield opening and match up marks on glass and frame.
18. Press glass lightly to set caulking material to windshield opening flanges. Paddle material where necessary to insure proper seal.
19. Water test windshield immediately using a cold water spray. If any water leaks are encountered, use flat bladed screw driver or stick, and paddle caulking material into leak point to correct leak. Correction of leak is usually more effectively performed by padding material from inside the body.
20. Install previously removed hardware and trim in the following order: upper reveal molding, side reveal molding, side retainer molding, and windshield pillar weatherstrip.

Make sure to reseal all surfaces that had foam backing torn during disassembly. Refer to Section 10B for waterleak prevention.

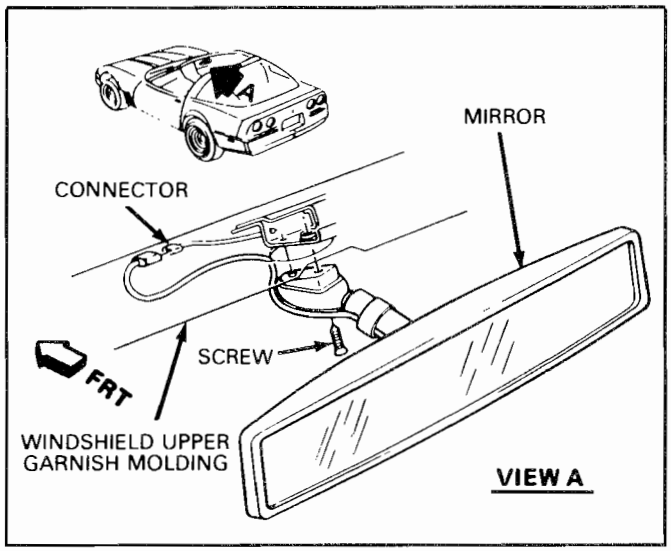


Figure 10-14 Inside Rearview Mirror

DOORS

ADJUSTMENTS

Door Lock Striker (Figure 10-19A)

The door lock striker consists of a single metal bolt and washer assembly that is threaded into a tapped, floating cage plate located in the body lock pillar. With this design, the door is secured in the closed position when the door lock fork-bolt snaps over and engages the striker bolt.

1. To adjust striker up or down, or in or out, loosen striker bolt and shift striker as required, and then tighten striker.
2. To determine if striker fore or aft adjustment is required, proceed as follows:
   a. Make certain door is properly aligned.
   b. Apply modeling clay or body caulking compound to lock bolt opening.
   c. Close door only as far as necessary for striker bolt to form an impression. Complete door closing will make clay removal very difficult.
   d. Measure striker impression as follows: Striker head should be centered fore and aft as shown; however, some tolerances are allowed. In this alignment, it is important that minimum dimensions as outlined in Figure 10-20 be strictly maintained. The following spacers are available as service

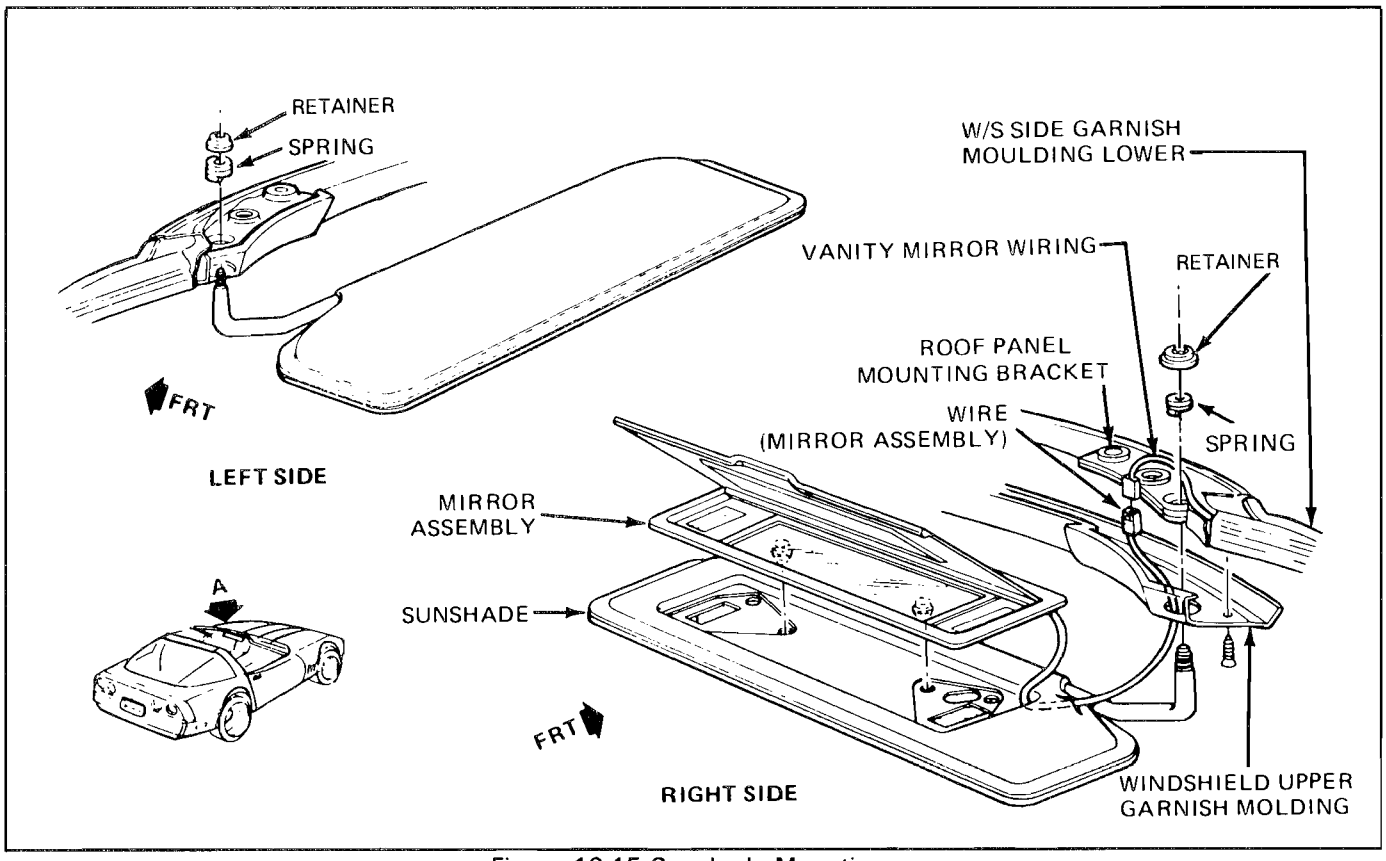


Figure 10-15 Sunshade Mounting

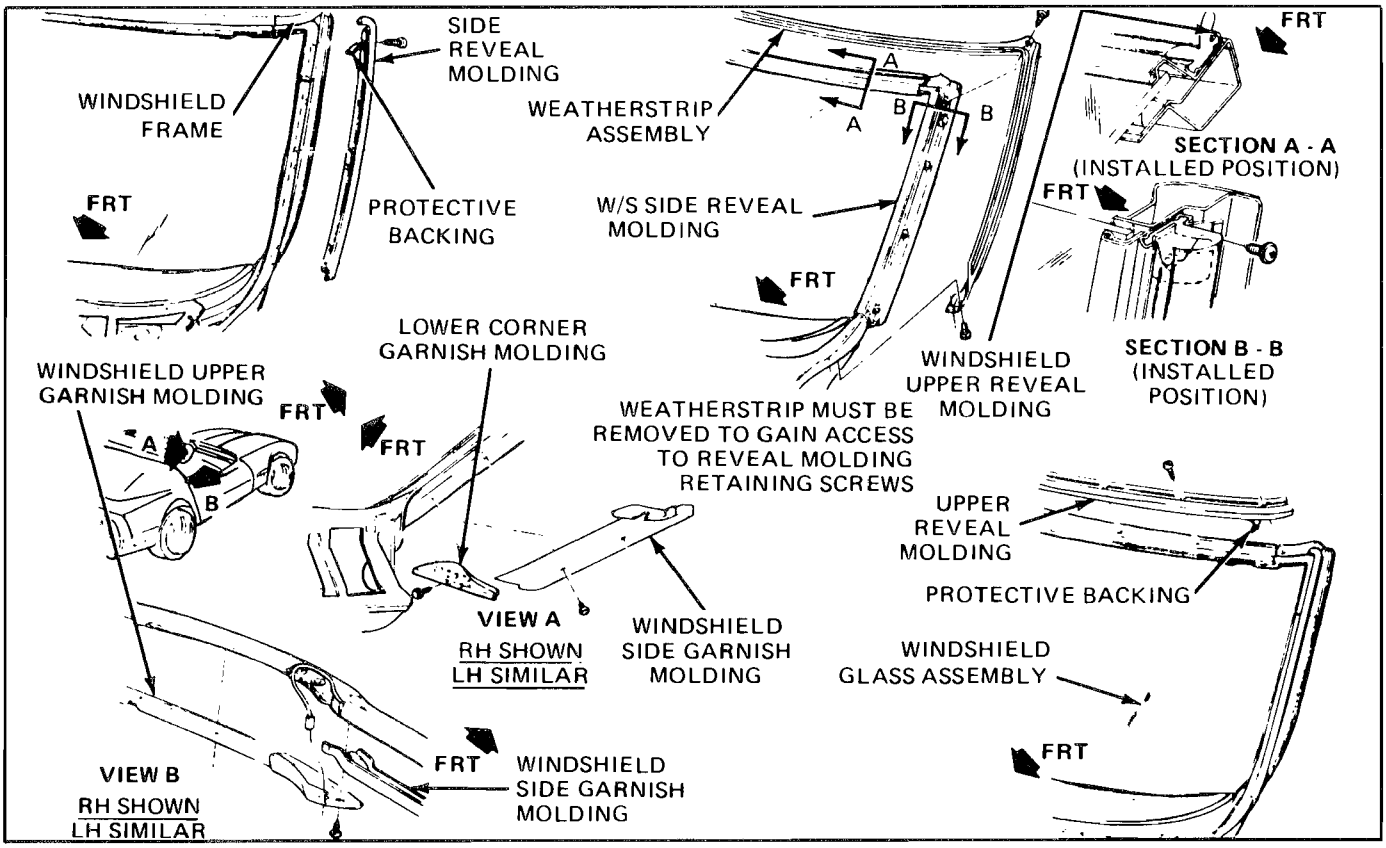


Figure 10-16 Windshield Reveal Moldings and Weatherstrip

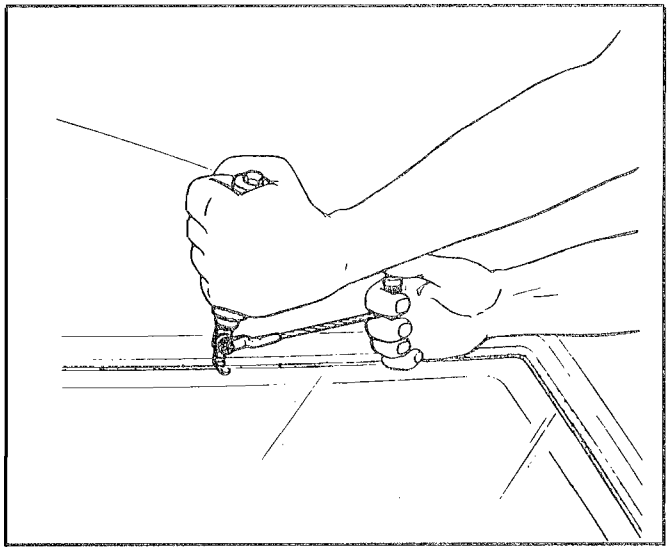


Figure 10-17 Removing Old Glass From Opening Using J-24402-A

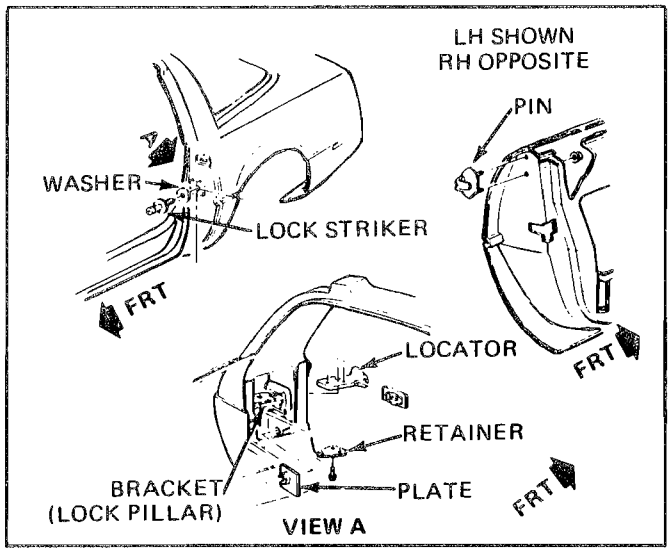


Figure 10-19A Lock Striker and Locator - Coupe

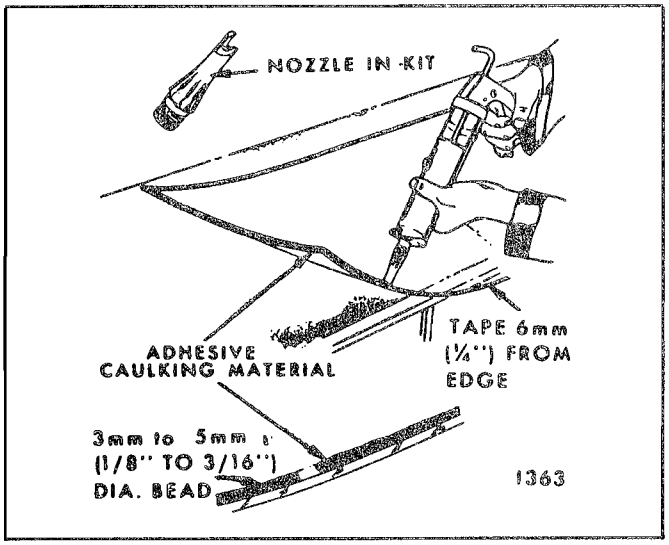


Figure 10-18 Adhesive Material Application

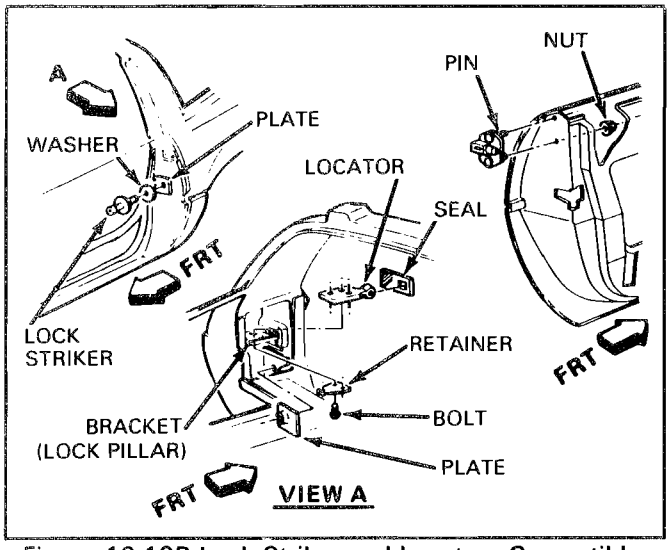


Figure 10-19B Lock Striker and Locator - Convertible

parts and can be used individually or in combination to achieve the specified alignment:

5/64" Spacer

5/32" Spacer

1/4" Spacer

5/16" Spacer

If check indicates need for spacers, proceed as follows:

1. Mark position of striker on body lock pillar using a pencil.
2. Insert J-23457 wrench into head of striker bolt and remove striker.
3. To install, reverse removal procedure. Make certain striker is positioned within pencil mark.

   Whenever a door has been removed and reinstalled or realigned, the door should not be closed completely until a visual check is made to determine if lock fork-bolt is correctly engaging with striker.

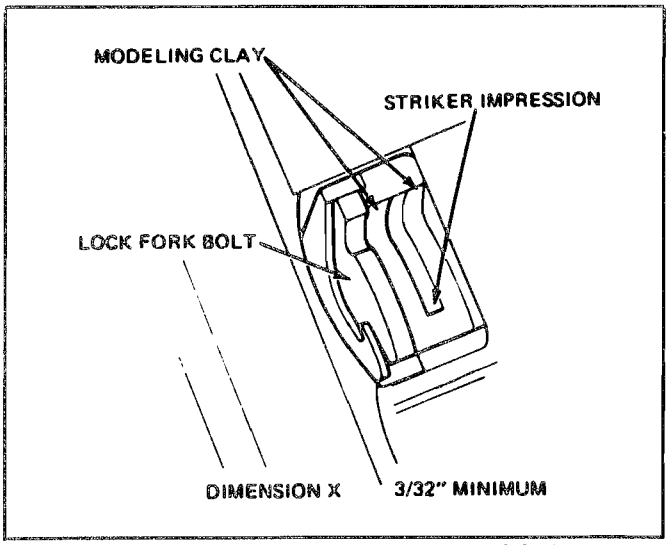


Figure 10-20 Checking Adjustment of Striker

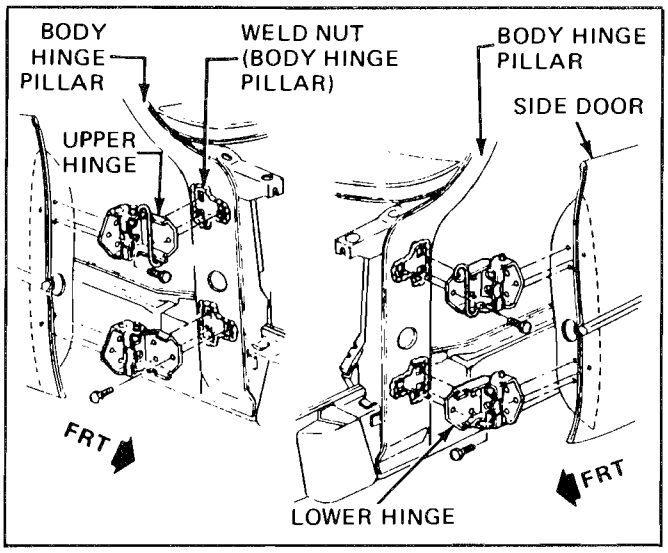


Figure 10-21 Side Door Hinges

DOOR HINGES (FIGURE 10-21)

Removal

Do not allow door to hang unsupported by one hinge.

1. Raise hood.
2. Disconnect battery ground cable.
3. If entire door is to be removed, support the door at the floor and disconnect wiring necessary to remove door from vehicle.
4. Open door. If hinge is to be replaced in same position, scribe mark about hinge.
5. Remove 3 hinge to hinge pillar attaching bolts. Then remove 3 hinge to door attaching bolts.
6. To remove lower hinge, the fender must first be removed to gain access to attaching bolts.

Installation

Install hinges reversing removal procedure.

DOOR SILL PLATE AND PAD (FIGURE 10-22)

Figure 10-22 shows assembly detail of door sill plate and pad. The sill plate which retains the carpet is mounted to the body using 6 screws. The sill plate must be removed first to replace the pad.

LOCK ASSEMBLY

If lock cylinder has to be replaced, refer to Figure 10-23.

DOOR TRIM PANEL (FIGURE 10-24)

Removal

1. Raise hood and disconnect battery cable.
2. Remove 2 screws attaching armrest to trim panel. Push armrest inward to remove plastic hooks on armrest from slot on door trim panel.
3. Remove speaker grille (4 screws).
4. Remove accessory trim plate screws (5), one screw behind door release handle.
5. Disconnect wire connectors to hatch lid release switch, door lock courtesy light and wiper-washer switch (left door only).
6. Remove remote control plate and courtesy lamp.
7. Remove upper molding and air outlet.

Installation

To install door trim panel, reverse the removal procedures.

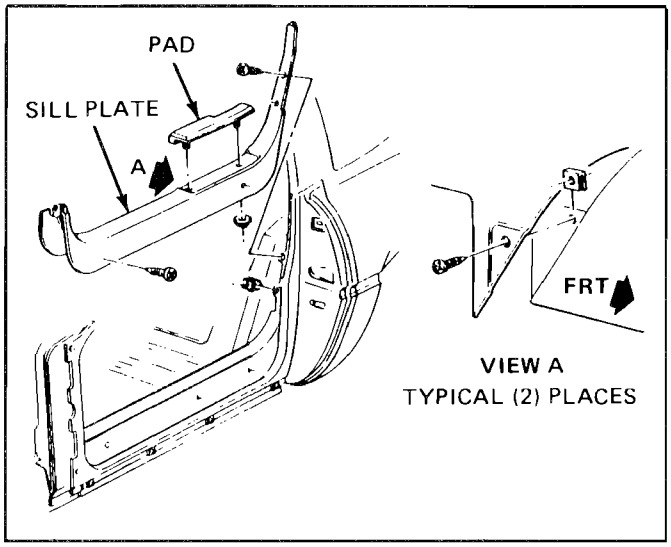


Figure 10-22 Sill Plate and Pad

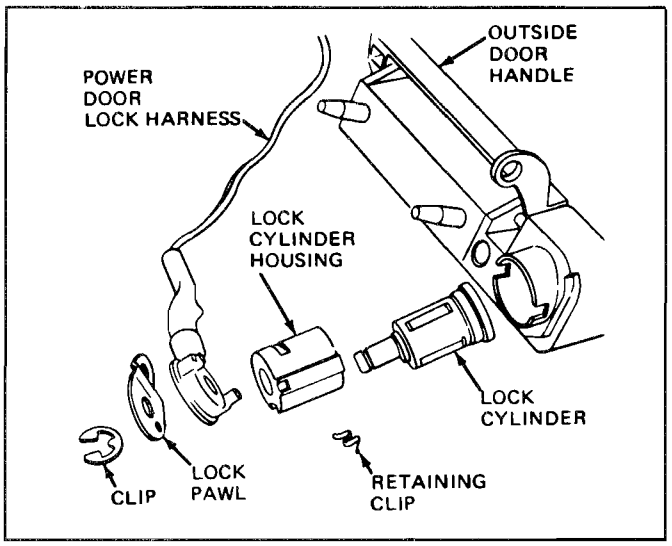


Figure 10-23 Door Lock Cylinder Assembly

DOOR LOCK AND REMOTE CONTROLS (FIGURE 10-25)

Removal

1. Disconnect battery ground cable.
2. Remove armrest.
3. Remove speaker grille.
4. Remove foam insulator.
5. Remove door trim panel.
6. Remove inner mounting plate.
   a. Disconnect wire harness rose bud clip.

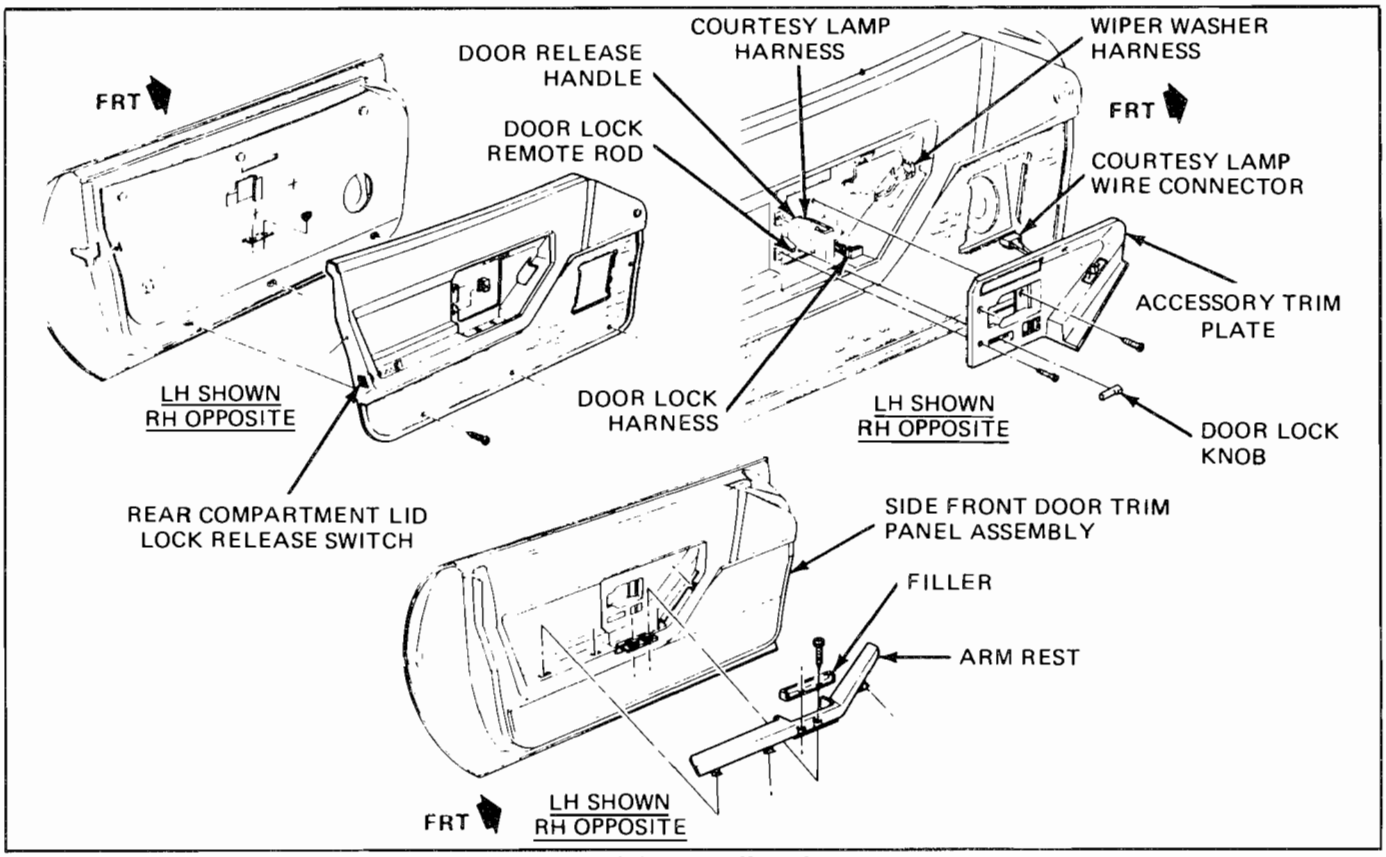


Figure 10-24 Door Trim Panel

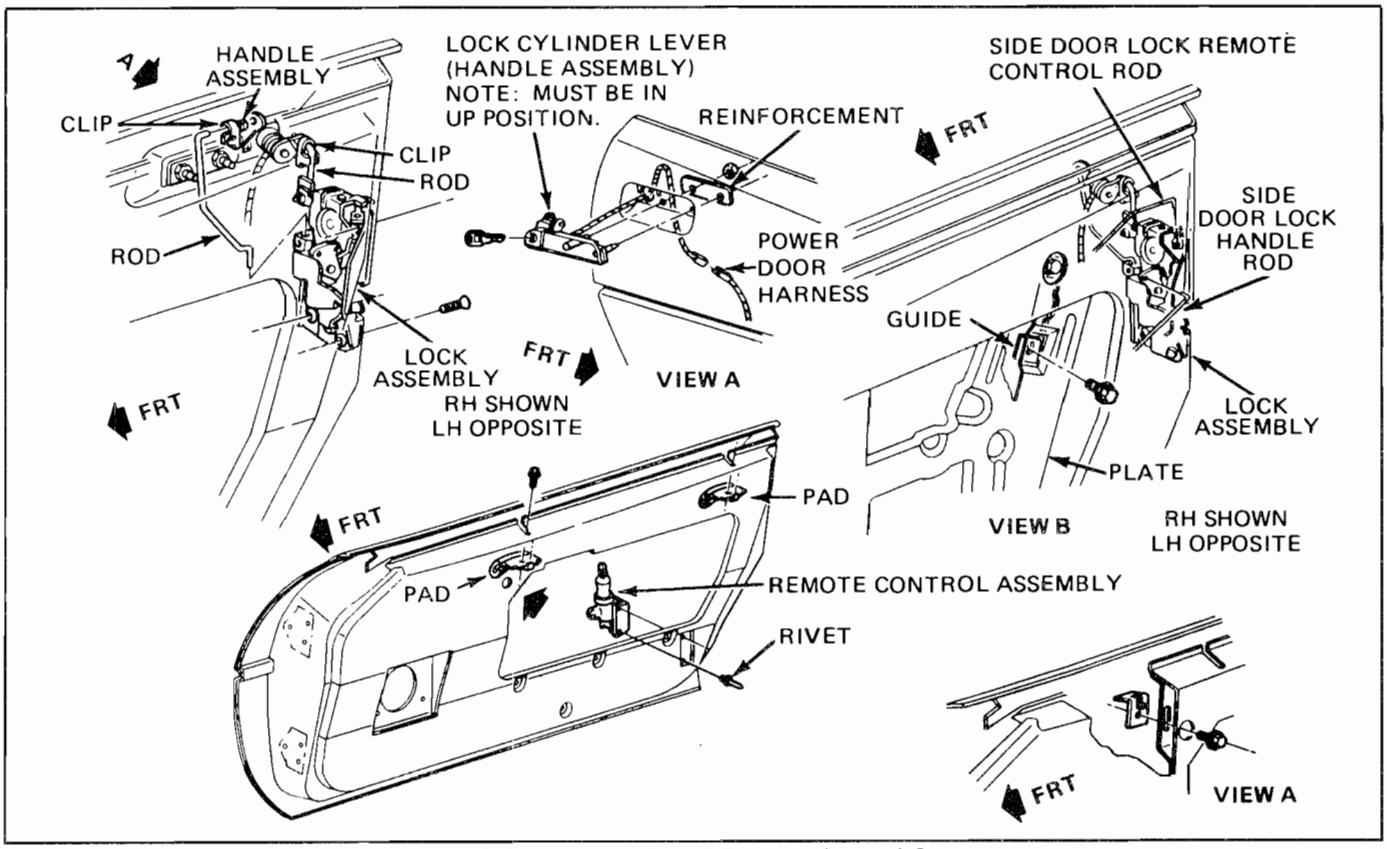


Figure 10-25 Door Lock and Remote Control System

b. Remove (8) screws to plate and (2) bolts.
c. Disconnect actuator rod.
d. Remove remote rod by pushing plate down and pull out slightly to remove clip.
e. Remove screws (3) to lock mechanism.
f. Disconnect lock cylinder rod.
g. Lower the lock mechanism, pushing the rod and plate assembly back into the door to access opening in the door for the lock. With rod and lever in sight, disconnect the clip and rod and remove the plate.

7. Remove (2) nuts and backing plate from handle. Disconnect power door lock connector. Place clips on remote rods as necessary to facilitate assembly.
8. Remove handle from vehicle.

DOOR WINDOW ADJUSTMENT (FIGURE 10-26A)

1. Disconnect battery ground cable.
2. Remove armrest.
3. Remove speaker grille.
4. Remove door trim panel as previously described.
5. Remove water separator.
6. Adjust glass as necessary at glass guide stops, anti-rattle cushions, regulator bolts top of door and saddle to glass.

SIDE WINDOW GLASS

Removal

1. Disconnect battery ground cable.
2. Remove armrest.
3. Remove speaker grille.
4. Remove door trim panel as previously described.
5. Remove water separator.
6. Mark location and loosen anti-rattle pads (2). Move to facilitate glass removal.
7. Move regulator into position to access glass nut holes in inner mounting plate.
8. Mark position and remove stabilizing guide and glass top.
9. Remove (3) glass to regulator nuts. Remove glass, remove studs and stop on glass through slot at top of door.

Installation

If replacement of glass is necessary, transfer studs and stop to new glass. Reverse removal procedure to install glass. Adjust as necessary and clean glass.

WINDOW REGULATOR-COUPE

Conditions encountered on regulators that have flex rack tracks which are not chrome, (Item 6, Figure 10-26B) but are yellow or gold in color, or dull metal finish, require replacement of complete regulator assembly.

Conditions encountered on regulators with chrome flex rack tracks (Item 6, Figure 10-26B) may be repaired with component parts (electric motors and or revised flex racks, Items 4 and 5, Figure 10-26B).

Removal (Figure 10-26A)

1. Lower glass slightly.
2. Disconnect battery negative cable.
3. Remove armrest.
4. Remove speaker grille.
5. Remove door trim panel as previously described.
6. Remove water separator.
7. Remove inner mounting plate.
   a. Disconnect wire harness connectors at rear of plate.
   b. Remove plate to door screws (8). Mark position of guide bolts.
   c. Remove (3) bolts (1) plate to motor, (1) guide to plate, (1) guide to door and remove guide.
   d. Disconnect rods at remote control and lock actuator (pull rod out of rubber at actuator), push plate down and pull top out to gain access to remote rod clip and pop out of plastic guide.
   e. Disconnect connector at window regulator motor.
   f. Pull plate out and let it hang from lock rod at rear of door.
8. Remove (2) screws at weatherstrip to window opening on door.
9. Mark position and remove glass stop bracket.
10. Loosen anti-rattle pads (2), move to facilitate glass removal.
11. Remove regulator to glass nuts and remove glass through top of door.
12. Remove (5) regulator bolts and remove from vehicle.

Installation

Reverse removal procedures to install regulator. Adjust glass as necessary.

Replacement of Electric Motor-Coupe

1. Remove regulator assembly from door and place on a clean work surface.
2. Using an electric drill motor and 4mm (5/32") drill bit, drill out four (4) attaching rivets that retain the electric window motor to the lower mounting plate (Item 3, Figure 10-26B).
3. Remove the motor from the regulator assembly and transfer the plastic drive gear to the new motor.
4. Clean the lower mounting plate of all metal shavings prior to motor installation.
5. Apply lubricant (GM P/N 1052349 or equivalent) to the drive gear, flex rack, track and gear housing on the lower mounting plate.
6. Install the new motor to the mounting plate using four (4) 4mm x 10mm (5/32" x 3/8") rivets (Item 3, Figure 10-26B).
7. Using an external power source, operate the regulator to insure quiet, free operation.
8. Reinstall regulator into door and align door glass as necessary.

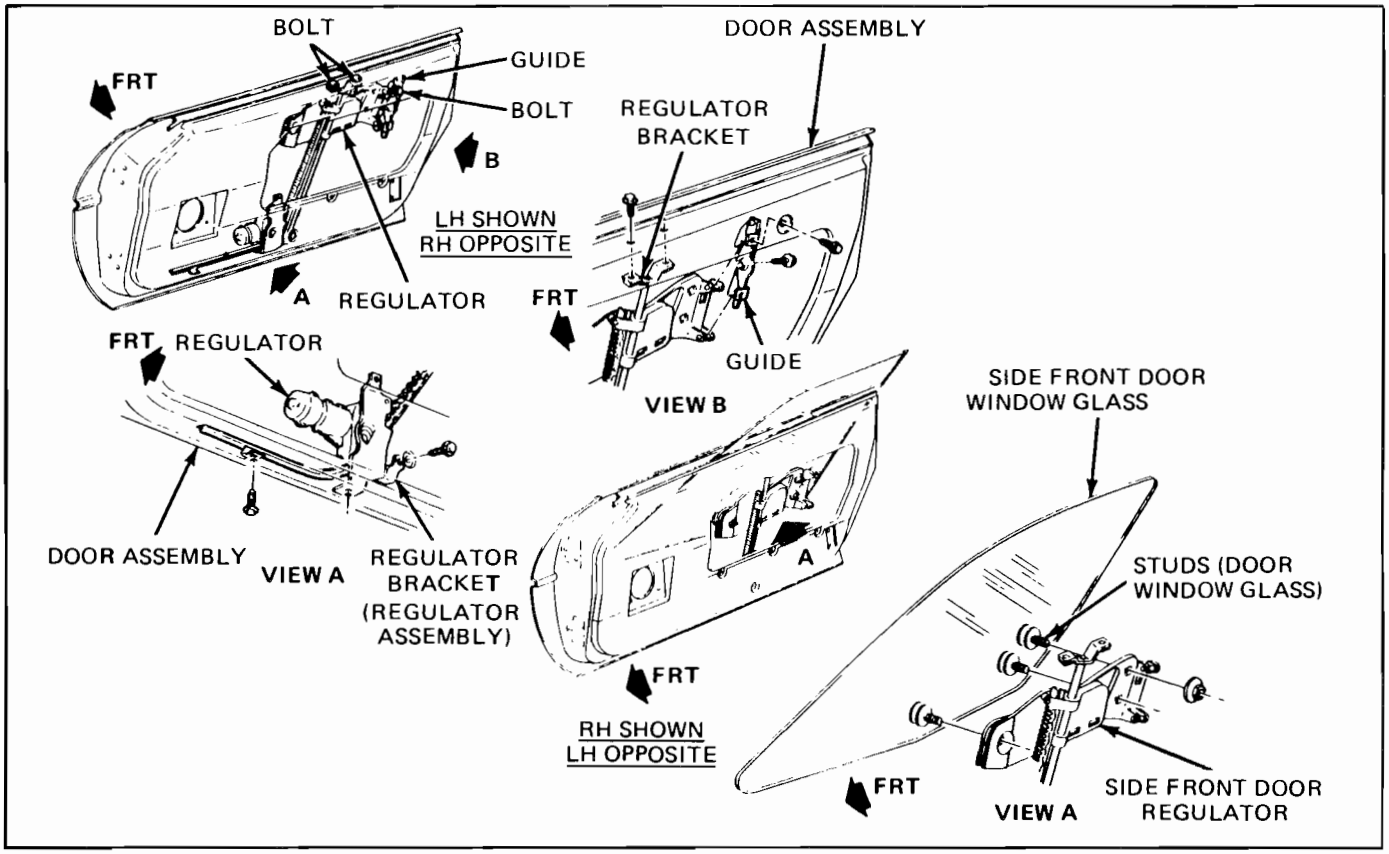


Figure 10-26A Door Window Glass and Regulator (Coupe)

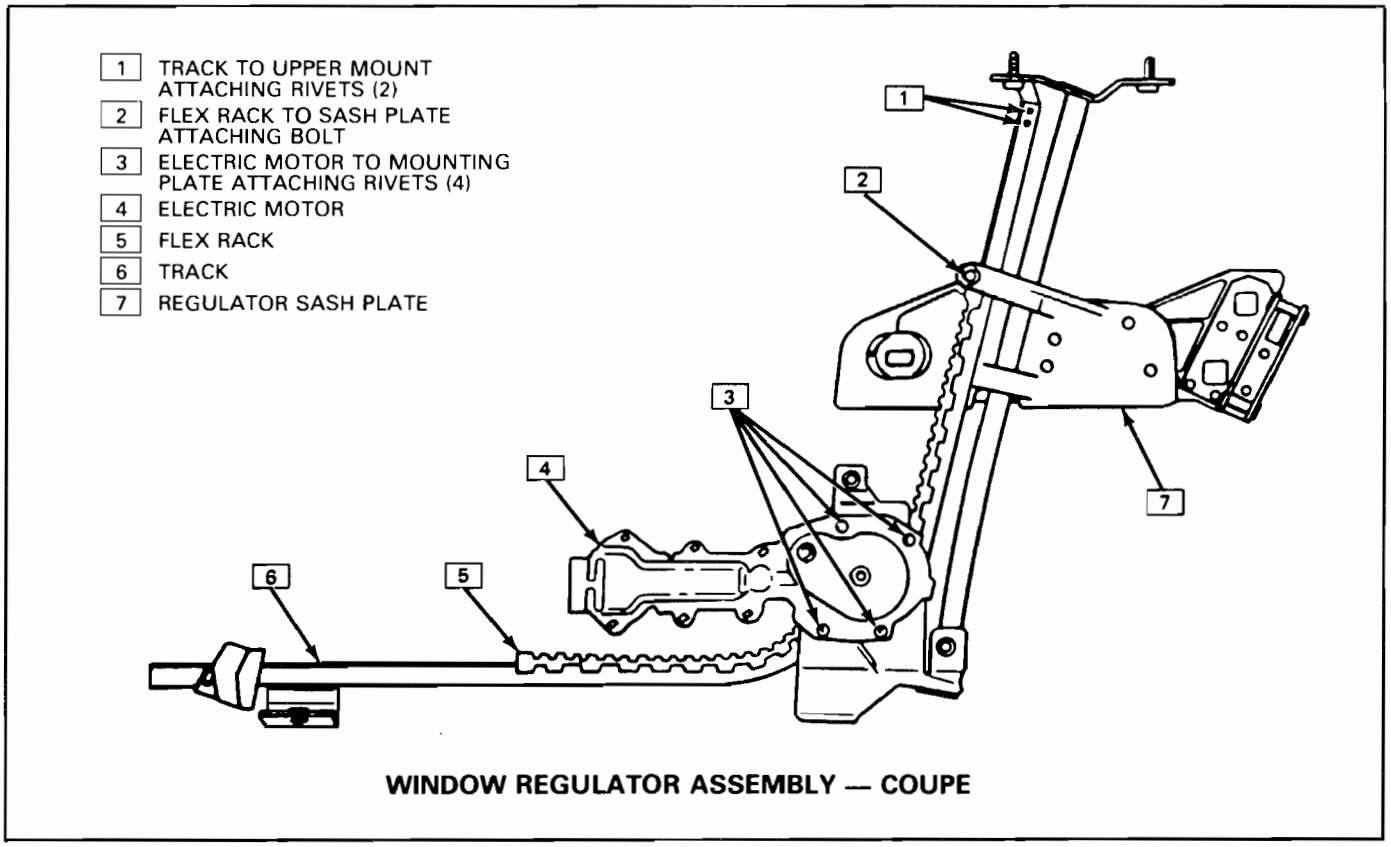


Figure 10-26B Regulator (Coupe)

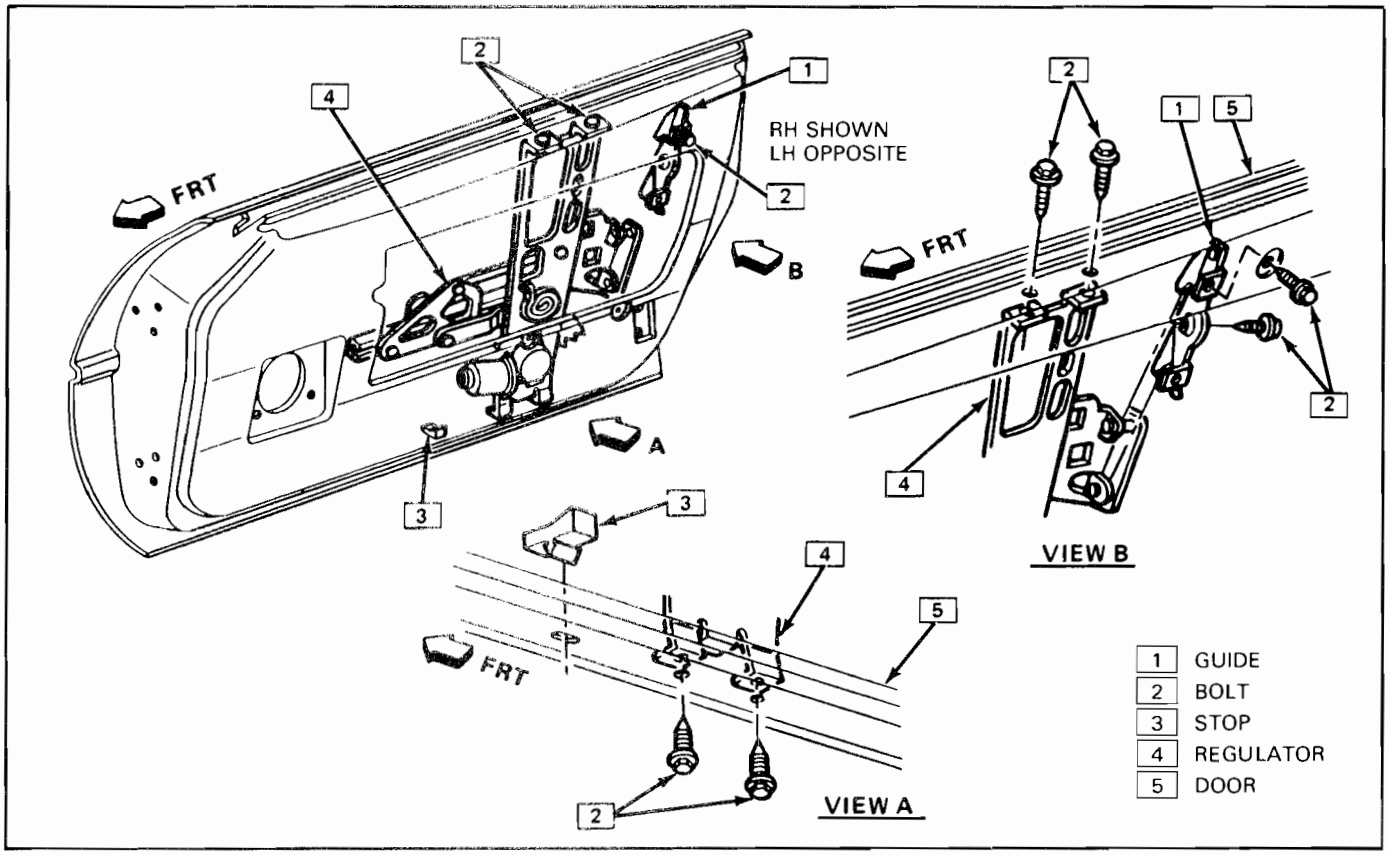


Figure 10-26C Door Window Regulator (Convertible)

Replacement of Plastic Flex Rack Gear-Coupe

1. Remove regulator assembly from door and place on a clean work surface.
2. Using an electric drill motor and 4mm (5/32") drill bit, drill out the two (2) track to upper mounting plate attaching rivets (Item 1, Figure 10-26B).
3. Remove the Allen head type bolt (Item 2, Figure 10-26B) retaining the flex rack to the regulator sash plate. It will be necessary to hold the attachment nut on the underside of the sash plate to prevent it from rotating.
4. Lift track away from upper mounting plate and carefully pull track away from guide tube in order to disengage the flex rack and track from the sash plate opening at (Item 2, Figure 10-26B).
5. Remove the old flex rack completely from the track by using the window motor and an external power source.
6. Clean track of all metal shavings prior to new flex rack installation.
7. Lubricate both sides of the new flex rack with P/N 1052349 or equivalent.
8. Slide the flex rack onto the track until engaged with motor gear. Use the motor with an external power source to pull the remaining flex rack onto the track.
9. Locate the flex rack and track into the sash plate opening at (Item 2, Figure 10-26B). Apply Loctite Thread Sealer, or equivalent, to the bolt threads prior to reinstalling the Allen type bolt at (Item 2, Figure 10-26B) to prevent loosening from vibration.
10. Locate and fasten track to the upper mounting plate using two (2) 4mm x 10mm (5/32" x 3/8") rivets (Item 1, Figure 10-26B).
11. Using an external power source, operate the regulator to insure quiet, free operation.
12. Reinstall regulator assembly into door and align glass as necessary.

WINDOW REGULATOR-CONVERTIBLE

Removal (Figure 10-26C)

1. Remove armrest, accessory trim plate, and door trim panel.
2. Remove inner panel liner.
3. Disconnect the following linkages from the inner mounting plate:
   - Power door lock linkage (clip).
   - Latch handle linkage from guides on back of mounting plate and clip at latch handle.
   - Door lock rod from guide on back side of mounting plate and at pivot.
4. Remove bolts holding inner mounting plate.
5. Remove window guide.
6. Lower inner mounting plate into door and remove by tilting mounting plate outward at the top.
7. Unclip wiring harness from inner mounting plate.
8. Remove glass stop.
9. Unbolt glass from regulator and remove.

10. Remove 2 upper and 2 lower regulator mounting bolts.
11. Disconnect power windows motor connector.
12. Remove regulator from door.

Installation

Reverse removal procedure, adjust glass as necessary.

FRONT DOOR WEATHERSTRIP-ALIGN OR REPLACE

Removal

1. Remove trim panel.
2. Remove (4) screws attaching weatherstrip to door.
3. Remove weatherstrip from door (25 clips).

Installation

1. Clean up weatherstrip surface.
2. Apply adhesive.
3. Reverse removal procedure for balance of installation.

FLOOR CARPETING

Replacement

In areas where carpeting is to be cemented, remove all old carpeting and insulation which may adhere to floor after original carpet is pulled up. Apply cement or equivalent following directions furnished with package. Be sure floor is reasonably clean and dry before applying cement or equivalent.

Rear Compartment-Intermediate

1. Remove seat cushions (right and left).
2. Remove seat assemblies.
3. Remove (2) screws at sill panel (1) at upper trim.
4. Remove (5) screws at front of rear storage compartment. Lift carpet up to release and remove carpet from vehicle.

Rear Compartment

1. Remove rear hatch lid opening trim-center section.
2. Remove lock cylinder assemblies and covers (2).
3. Remove rear center carpet.
4. To install, reverse removal procedure.

Rear Compartment Floor Panel Carpet-Wheelhouse

Removal

1. Remove center section trim panel at rear hatch lid opening.
2. Remove cargo shade.
3. Remove wheelhouse carpet retainer and (1) screw in the side trim.
4. Remove rear speaker grille.
5. Remove roof cover storage bracket.
6. Remove (2) screws at sill molding (2) at roof trim. Also, remove storage compartment screws.
7. Remove carpet.

Installation

If new carpet is being installed, cut out speaker and bracket holes. Reverse removal procedures to install carpet.

GAS TANK DOOR

Figure 10-28 illustrates installation details of gas tank door. Gas tank door assembly and bezel are replaced by removing screws located around inner surface of bezel.

SEAT ASSEMBLY (FIGURE 10-29)

Replacement

1. Move seat to forward position and fold seat back forward to reveal support bracket rear bolts. Remove rear nuts.
2. Reposition seat back and slide seat rearward. Remove trim cover to reveal front support bolts and remove nuts.
3. Repair assembly or transfer usable components to new unit. Reinstall seat assembly using reverse of removal procedure.

FRONT SEAT ADJUSTER ASSEMBLY MANUAL (FIGURE 10-29)

Removal

1. Remove seat cushion by pulling on retaining wire at front of seat frame.
2. Remove (4) seat frame to adjuster bolts (one side).
3. Remove adjuster from vehicle.
4. Reinstall by using reverse of removal procedure.

SIX-WAY POWER OPERATED SEAT

The driver's seat assembly is fastened to the floor pan by (4) nuts to studs attached to the floor pan. There are electrical connectors from the motor to the switch and from the switch harness to the body harness (Refer to Figure 10-30).

FRONT SEAT POWER ADJUSTERS POWER SEAT (FIGURE 10-30)

Removal

1. Disconnect battery ground cable.
2. Remove seat cushion to gain access to adjuster bolts.
3. Remove seat assembly to adjuster. Remove seat.
4. Remove front adjuster leg trim covers.
5. Remove power seat mechanism to floor pan stud nuts (4).
6. Disconnect wire connector to adjuster and remove power seat mechanism.
7. Remove cable retainer to motor screws (2) and remove cable.
8. Remove vertical adjuster spring prying off or out of slot with screwdriver.

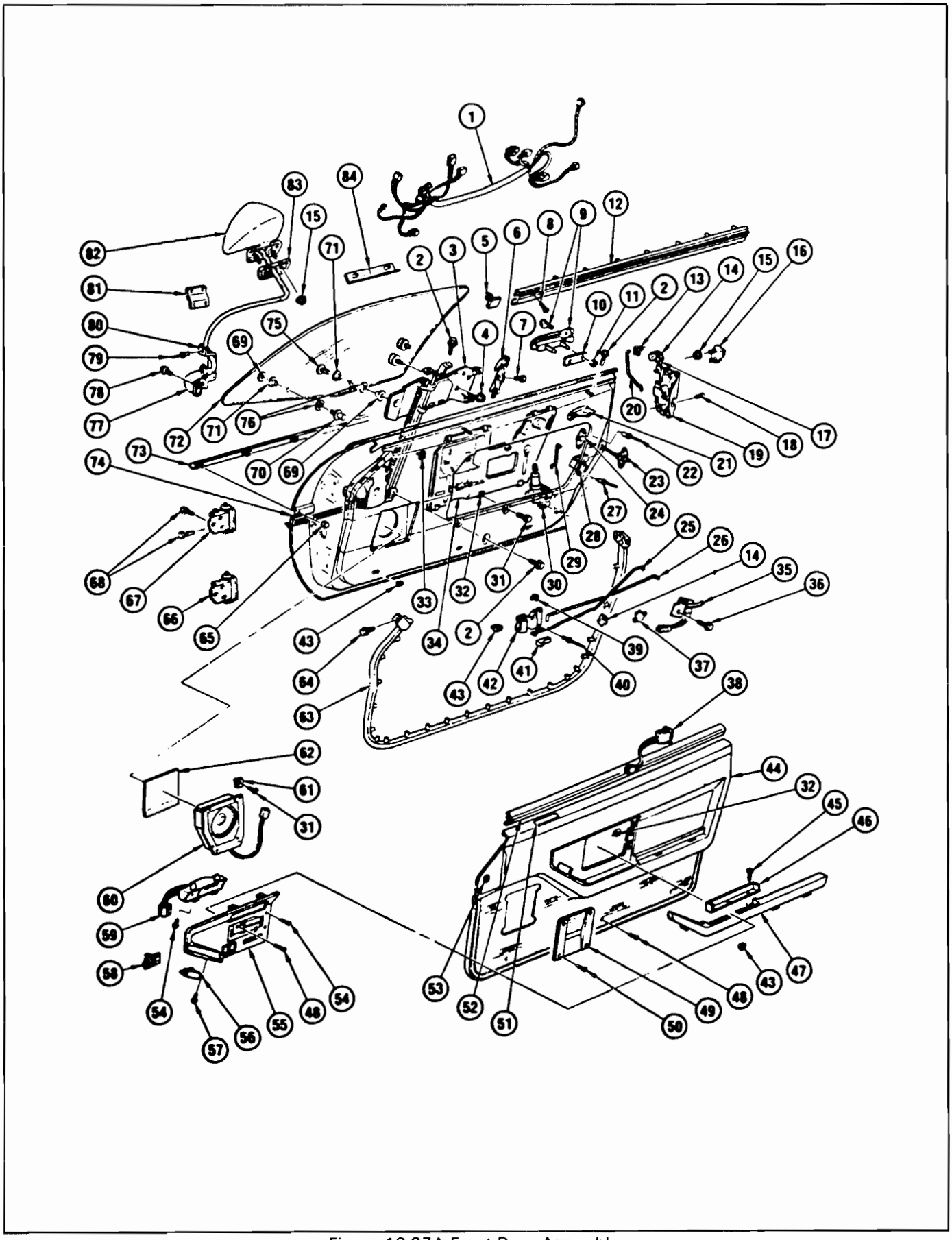


Figure 10-27A Front Door Assembly

1. Power Window Harness
2. Bolt/Washer
3. Front Door Regulator
4. Front Door Window Nut
5. Sealing Strip Retainer
6. Front Door Window Guide
7. Guide Bolt
8. Screw
9. Door Handle Assembly
10. Door Handle Reinforcement
11. Nut
12. Outer Seal Strip
13. Handle Rod Clip
14. Remote Control Rod Connector
15. Nut
16. Guide Pin
17. Lock Cylinder Rod
18. Screw
19. Lock
20. Handle Rod
21. Window Cushion
22. Rivet
23. Door Ajar Indicator Switch
24. Door Ajar Indicator Switch Retainer
25. Lock Remote Control Rod
26. Inside Handle Lock Rod
27. Rivet
28. Wiring Lower Bracket
29. Lock Remote Control Rod
30. Power Door Lock Actuator
31. Screw
32. Nut
33. Window Stop
34. Accessory Plate
35. Theft Deterent Switch
36. Bolt
37. Lock Rod Guide
38. Hatch Compartment Lid Release Switch
39. Clip Inside Door Handle
40. Rivet
41. Lock Rod Knob
42. Inside Door Handle
43. Anchor Nut
44. Front Door Trim Panel
45. Bolt
46. Arm Rest Filler
47. Arm Rest
48. Screw
49. Speaker Grille
50. Screw
51. Bezel
52. Glass Seal
53. Defroster Duct Bezel
54. Screw
55. Trim Plate
56. Windshield Washer/Wiper Switch
57. Screw
58. Power Door Lock Switch
59. Dome Lamp
60. Speaker/Amplifier
61. Nut
62. Speaker Opening Cover
63. Weatherstrip
64. Screw/Washer
65. Nut
66. Lower Door Hinge
67. Upper Door Hinge
68. Bolt/Washer
69. Nut
70. Window Glass Stud
71. Bushing/Washer
72. Side Door Window Glass
73. Molding
74. Door Panel
75. Window Glass Stud
76. Window Glass Washer
77. Wiring Conduit
78. Screw
79. Rivet
80. Wiring Guide
81. Wiring Bracket
82. Outside Rear View Mirror
83. Outside Rear View Mirror Seal
84. Outside Rear View Mirror Wiring Retainer

Figure 10-27B Front Door Assembly (Legend)

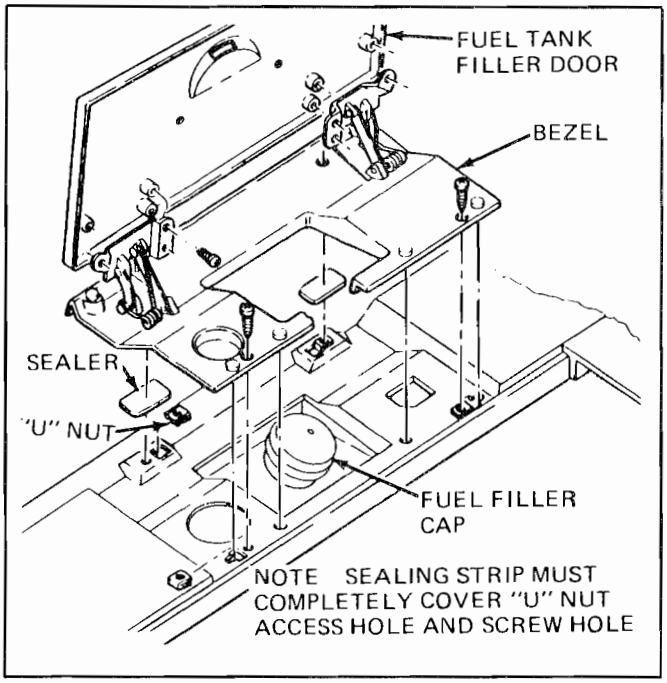


Figure 10-28 Fuel Tank Filler Door Assembly

9. Remove cotter pins (2) at left side adjuster and split carriage. This may require some light tapping with a mallet to disengage the drive shaft at the transmission. The shaft is tubular and is fitted over a mating shaft at transmission.
10. Remove drive shaft - pry out at left adjuster.
11. Remove adjuster from rack and seat mounting.
12. Remove horizontal adjuster springs.
13. Remove (3) bolts and (2) at spring retainer.
14. Remove rack from adjuster at carriage assembly.

Installation

1. Replace by aligning adjuster in rack and slide block to other slide. Place the plastic side blocks on mating surface to rack and gear. Reverse removal procedures to install except for the following:

- Align adjusters before replacing in Step 8.
- In Step 3, adjuster can be moved into position by motor to access attaching bolts.

ELECTRIC MOTOR (FIGURE 10-30)

Replacement

1. Remove the carriage assembly from the seat as described previously.
2. Line up access hole in the left side rack and mounting base and remove mounting base to motor screws (2).
3. To install, reverse removal procedure, lubricate all gears and frictional surfaces.

POWER SEAT TRANSMISSION (FIGURE 10-30)

Replacement

The transmission is serviced as an assembly only.

1. Remove right horizontal adjuster and the left rack as previously described.
2. Remove spring clips at the three cable connectors at the transmission.
3. Remove the transmission.
4. To install, reverse removal procedure.

SEATBACK CUSHION (BASE SEAT)

Replacement

1. Locate seatback cushion retainer clips by carefully pushing away seat trim.
2. Cut all hog rings and remove cover.
3. To install cushion, reverse removal procedure.

SEAT CUSHION OR COVER

Replacement

1. Remove seat cushion by pushing down on front of seat and releasing retainer wire at front of seat frame.
2. Remove cover to cushion hog retainers.
3. Reverse removal procedures for installation.

SEATBACK HINGES

Removal

1. Remove seat cushion and seat back cushion.
2. Remove (4) bolts to adjuster through seat frame and remove seat assembly.
3. Drill out (2) rivets holding release (lock) at seat hinge assembly.
4. Remove (3) bolts from either side of the hinge assembly to back panel. Remove back panel.
5. Release actuator and remove (1) bolt at hinge and (1) bolt at seatback frame panel and actuator.
6. Remove (3) bolts at either side of hinge to seat cushion frame panel to, remove hinge.
7. To install, reverse removal procedure.

OPTIONAL SPORT SEAT

GENERAL DESCRIPTION (FIGURE 10-31A)

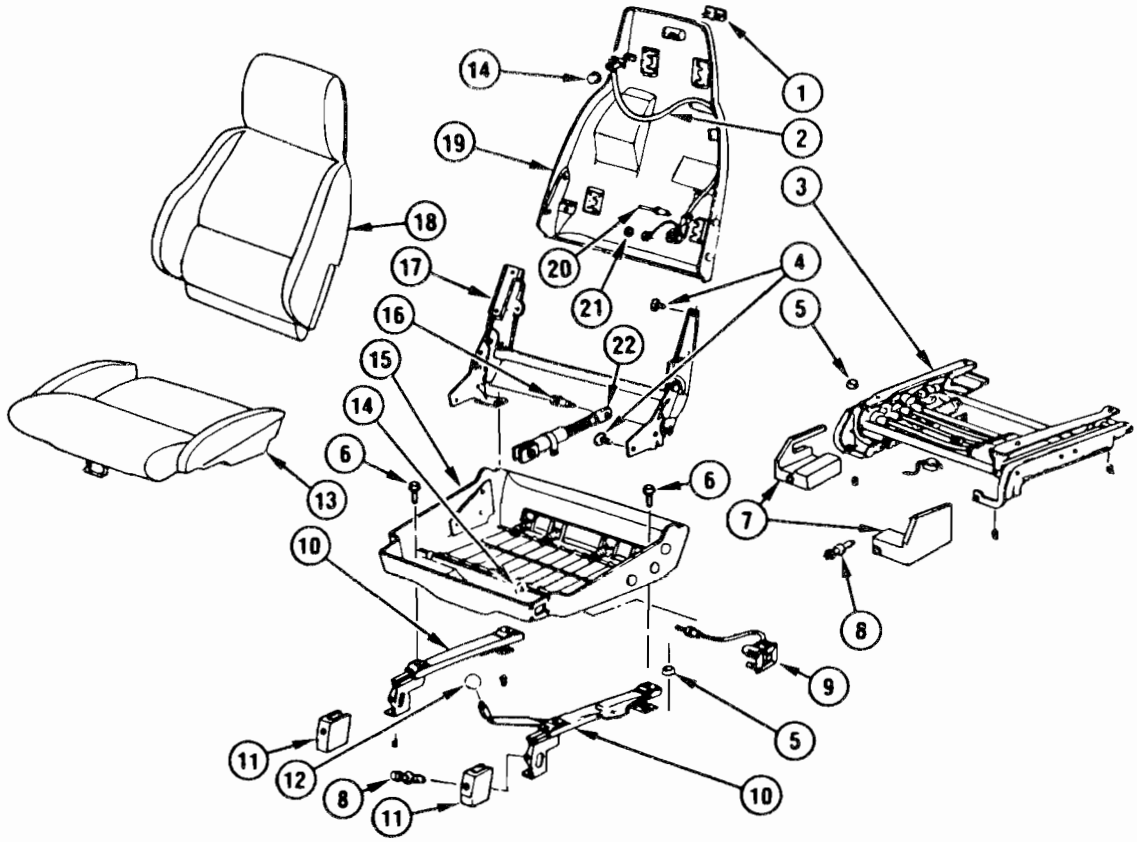
The available sport seat configuration is similar to the base seat except it can be adjusted to fit driver's body contour. The backseat lateral restraints (side bolsters) are power-adjusted fifteen degrees in or out. Lumbar support (backseat) can be power-pneumatically adjusted from soft to firm by inflating the three compartments located in the seatback cushion. Inflation of the three compartment bladders is controlled by a pressure pump, three bleed down valves, and a control located on the right bolster.

The seatback angle is power adjustable over a twelve degree travel by a control in the left bolster. The sport seat is available with a manual fore and aft adjustment or a six-way power adjustment.

REPLACEMENT SEAT ASSEMBLY

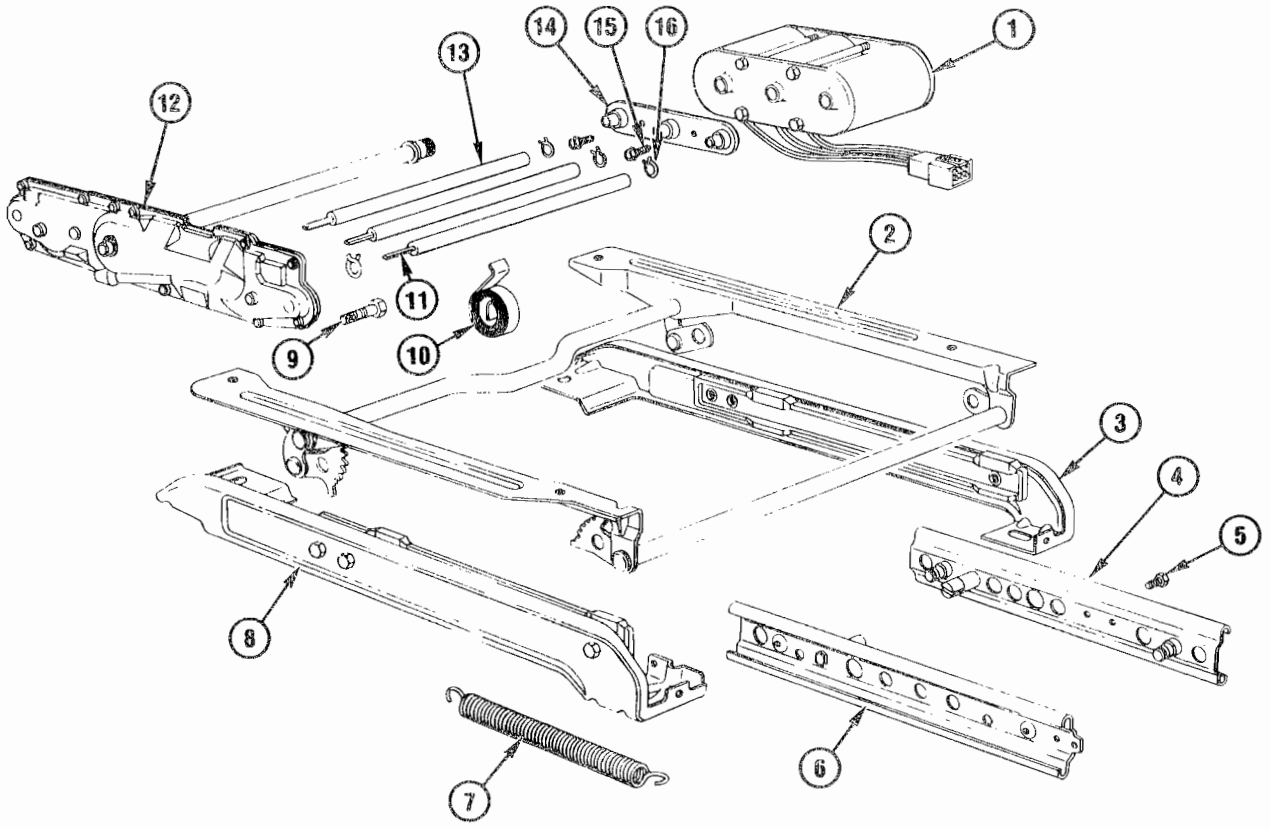
The sport seat can be removed and replaced from the vehicle using the procedures shown for the base or six way power seat previously described in this section.

NOTICE: Care must be taken so as not to pull power connectors apart.



1. BEZEL, SEAT BACK RELEASE HANDLE
2. RELEASE, SEAT BACK
3. ADJUSTER, DRIVER'S SEAT
4. BOLT, SEAT BACK HINGE
5. NUT, WASHER
6. BOLT
7. COVER, DRIVER SEAT ADJUSTER, COVER, PASSENGER SEAT ADJUSTER
8. RETAINER, ADJUSTER COVER
9. LEVER, BACK ADJUSTER ACTUATOR
10. ADJUSTER, RIGHT AND LEFT HAND SEAT
11. COVER, SEAT ADJUSTER
12. KNOB SEAT ADJUSTER
13. TRIM, CUSHION CLOTH
14. NUT
15. FRAME, SEAT CUSHION
16. BOLT
17. HINGE SEAT BACK
18. TRIM, SEAT BACK CLOTH
19. FRAME, SEAT BACK
20. RIVET
21. RETAINER
22. ACTUATOR, SEAT BACK ADJUSTER

Figure 10-29 Seat Assembly



1.	MOTOR	9.	SCREW
2.	SUPPORT, Upr St Adj	10.	SPRING
3.	BASE	11.	CABLE
4.	CARRIAGE	12.	TRANSMISSION
5.	SCREW	13.	HOUSING
6.	CARRIAGE	14.	RETAINER
7.	SPRING	15.	SCREW
8.	BASE	16.	CLAMP

Figure 10-30 Power Seat Assembly Components

BACK ANGLE OR SIDE BOLSTER SWITCH

With Seat in Vehicle

Remove

1. Disconnect battery ground cable.
2. Remove seat cushion by pulling on retaining wire at front of seat frame.
3. Disconnect electrical connector.
4. Remove two screws retaining left side control panel escutcheon.
5. Pull the escutcheon with switches attached out of the armrest.
6. Replace switch.

Installation

Reverse removal procedures.

LUMBAR CONTROL ASSEMBLY OR VALVE BODY

Removal

1. Disconnect battery ground cable.
2. Remove seat cushion and release bail clip from frame panel.
3. Disconnect pneumatic tubing and electrical connector to control.
4. Remove (1) hog ring at underside of seat to access control.
5. Remove esutcheon plate (retained by (2) screws) and remove control assembly through bottom of seat cushion. Also, if necessary, the valve body can be replaced at this time.

Installation

Reverse removal procedure.

LUMBAR MOTOR AND PUMP ASSEMBLY

Removal

1. Disconnect battery ground cable.
2. Remove seat cushion.
3. Remove four cushion frame panel to adjuster retaining bolts, disconnect electrical connector and remove seat from vehicle.

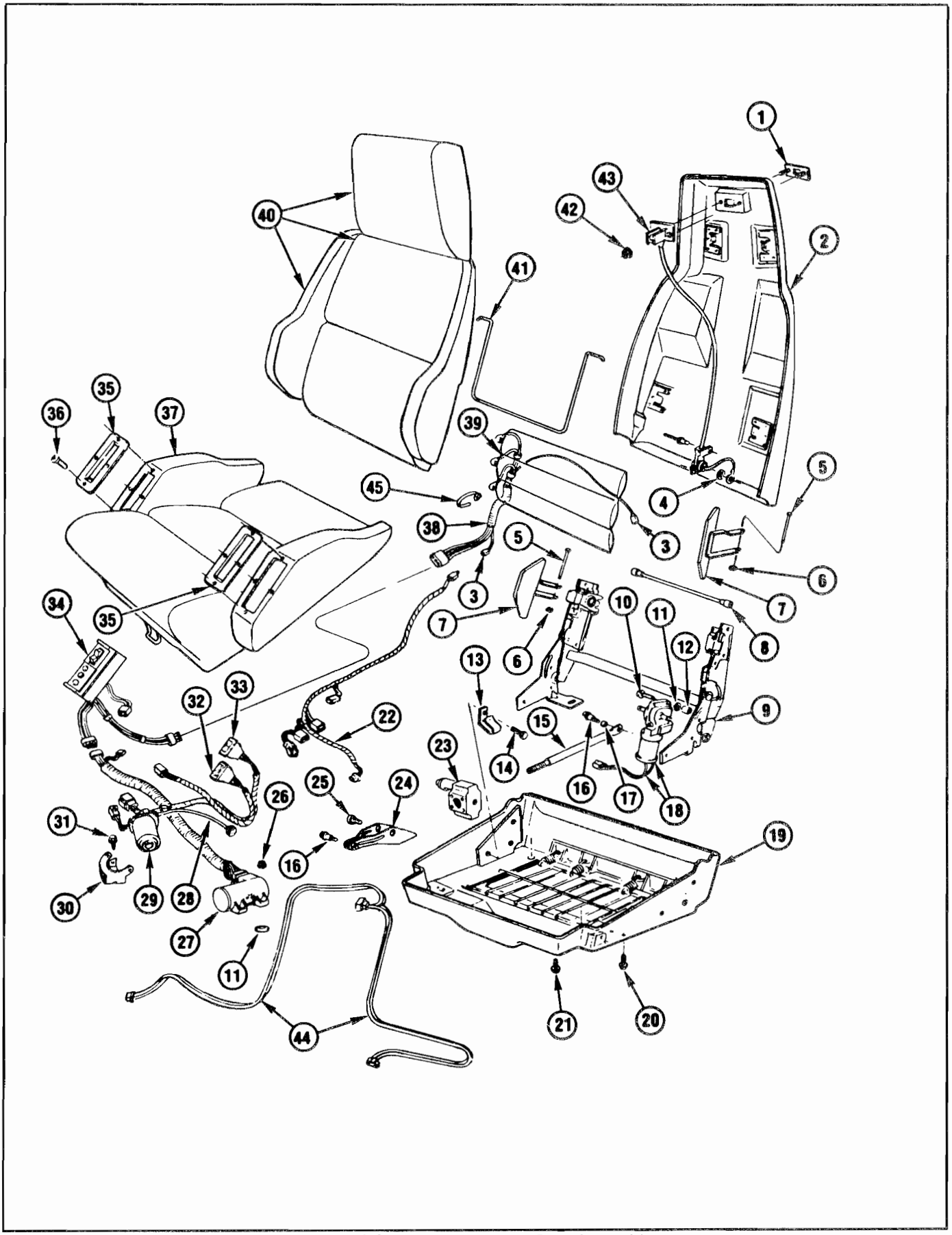


Figure 10-31A Sport Recliner Seat Assembly

1. **ESCUTCHEON,** Seat Back Release Handle
2. **FRAME,** Backrest
3. **HARNESS,** Jumper
4. **RETAINER,** Push-on
5. **PIN,** Bolster Adj Paddle
6. **RING,** Snap, Arm and Paddle Pivot Pin
7. **ARM,** W/Paddle, Bolster-LH
   ARM, W/Paddle, Bolster-RH
8. **CABLE,** Bolster Drive
9. **HINGE,** Seat Frame
10. **SCREW,** Bolster Motor Bracket
11. **WASHER,** Motor Insulating (Rubber)
12. **SPACER,** Bolster Motor
13. **CLIP,** Tube Retaining
14. **BOLT**
15. **LEADSCREW,** Bracket
16. **BOLT,** Gearnut Bracket and Leadscrew
17. **SPACER,** Backrest Leadscrew
18. **MOTOR,** Bolster Adjust
19. **FRAME,** Seat Cushion
20. **SCREW,** Gearnut Bracket
21. **SCREW,** Lumbar Motor Attaching
22. **HARNESS,** Cushion Wiring
23. **GEARNUT,** Seat Recliner Adjust
24. **BRACKET,** Backrest Gearnut
25. **SCREW,** Gearnut Attach
26. **NUT,** Lumbar Motor Attach
27. **MOTOR,** W/Pump, Lumbar Control
28. **CABLE,** Backrest Drive
29. **MOTOR,** Backrest Drive
30. **BRACKET,** Backrest Motor
31. **BOLT,** Backrest Motor Attach
32. **SWITCH,** Backrest Control
33. **SWITCH,** Bolster Control
34. **POD,** Lumbar Control
35. **ESCUTCHEON,** Seat Control-LH
    ESCUTCHEON, Seat Control-RH
36. **SCREW**
37. **PAD,** Seat Cushion
    TRIM, Seat Cushion
38. **CONDUIT,** Electrical
39. **BLADDER,** Lumbar Support
40. **PAD,** Backrest Cushion
    TRIM, Backrest Bolster
    TRIM, Backrest Center Insert
41. **WIRE,** Backrest Pad Retainer
42. **NUT**
43. **RELEASE,** Seat Back
44. **HARNESS,** I/P Wiring to Seat Extension
45. **STRAP,** Plastic 7" Adjust

Figure 10-31B Sport Recliner Seat Assembly (Legend)

4. Disconnect electrical and pneumatic harness connectors at motor.
5. Remove motor and pump assembly to frame attaching parts (3 nuts and bolts), and remove motor from seat cushion frame.

Installation

Reverse removal procedure, check operation of motor and pump.

BACK REST ANGLE ADJUSTING MOTOR

Removal

1. Disconnect drive cable at motor.
2. Disconnect electrical connector at motor.
3. Remove motor to seat frame attaching bolts (2), and remove from seat cushion frame.

Installation

Reverse removal procedure and check operation of motor.

BLADDER ASSEMBLY

Removal

1. Disconnect upper seatback cushion to back frame panel retaining clips (2).
2. Remove seatback cover to bolster cover retaining rings. One side, remove the retaining rings across the bottom of seatback and from bottom up to first division in seatback to gain access to bladder.
3. Remove retaining rings (hog rings) attaching bladder to seatback rails.
4. Disconnect air pump harness. Remove bladder from seatback.

Installation

Reverse removal procedure and check operation of bladder.

BOLSTER ADJUSTING MOTOR

Removal

1. Disconnect upper seatback cushion to back frame panel retaining clips (2).
2. Remove seatback cover to bolster cover retaining rings, one side, remove the retaining rings (hog rings) across bottom of seatback.
3. Pull bolster cover off pad (cover still attached to back panel) and seatback cushion outward to gain access to motor.
4. Punch out roll pin at motor end of drive cable and remove from motor.
5. Disconnect electrical connector.
6. Remove bolster motor attaching parts (3 screws, spacers and rubber washers).

Installation

Reverse removal procedures.

BOLSTER ADJUSTER CABLE/FLEX DRIVE

Removal

1. Disconnect upper seatback cushion to back frame panel retaining clips (2).

2. Remove seatback cover to bolster cover retaining ring. On one side, remove the retaining rings (hog rings) across bottom of seatback.
3. Pull bolster cover off pad (cover still attached to back panel) and seatback cushion outward to gain access to cable.
4. Punch out roll pins at each end of cable and remove cable from seatback.

Installation

Reverse removal procedures and check cable for binding condition.

PADDLE AND ARM ASSEMBLY

Removal

1. Disconnect upper seatback cushion to back frame panel retaining clips (2).
2. Remove seatback cover to bolster cover retaining rings (hog rings). On one side, remove the retaining rings across bottom of seatback.
3. Pull bolster cover off pad (cover still attached to back panel) and seatback cushion outward to gain access to paddle.
4. Remove paddle to hinge retaining pin (both sides if necessary.).

Installation

Reverse removal procedures. If service to the bolster transmission is required, the complete hinge assembly must be replaced.

SEAT CUSHION FRAME HINGE AND/OR BACKREST RELEASE CONTROL ASSEMBLY

Removal

1. Remove paddle and arm assemblies as previously described.
2. Drill out (2) rivets holding release (lock) at seat hinge assembly (left side).
3. Remove three hinge assembly to back panel attaching bolts.
4. Remove backrest release control attaching nut at the seatback frame panel and actuator.
5. Remove (3) hinge to seat cushion frame panel attaching bolts. Remove hinge assembly.

Installation

Reverse removal procedure.

BACKREST FRAME ASSEMBLY

Removal

1. Remove seat cushion.
2. Disconnect seatback cushion upper retaining clips (2).
3. Remove seatback cover to bolster cover (both sides) and retaining rings (hog rings) across bottom of seatback.
4. Remove bolster cover to panel staples.
5. Remove three hinge assembly to back panel attaching bolt (both sides) and remove backrest frame.

Installation

Reverse removal procedure.

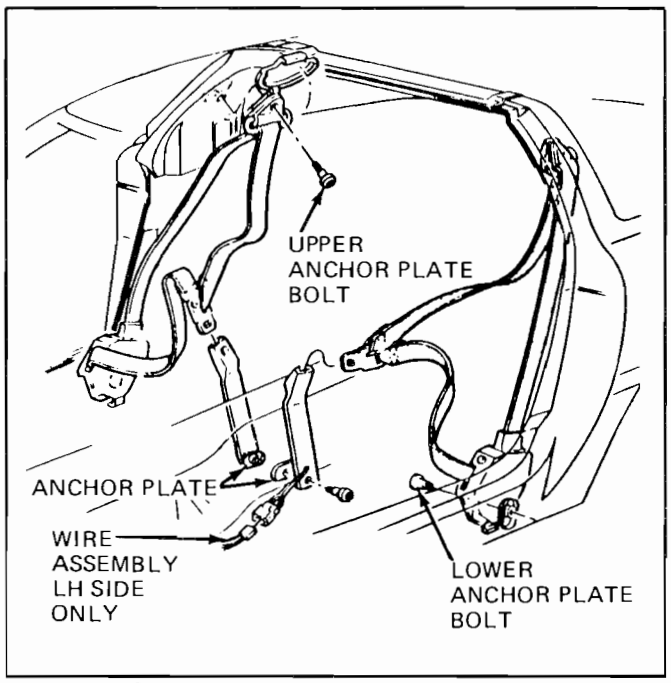


Figure 10-32A Seat Belt and Shoulder Harness (Coupe)

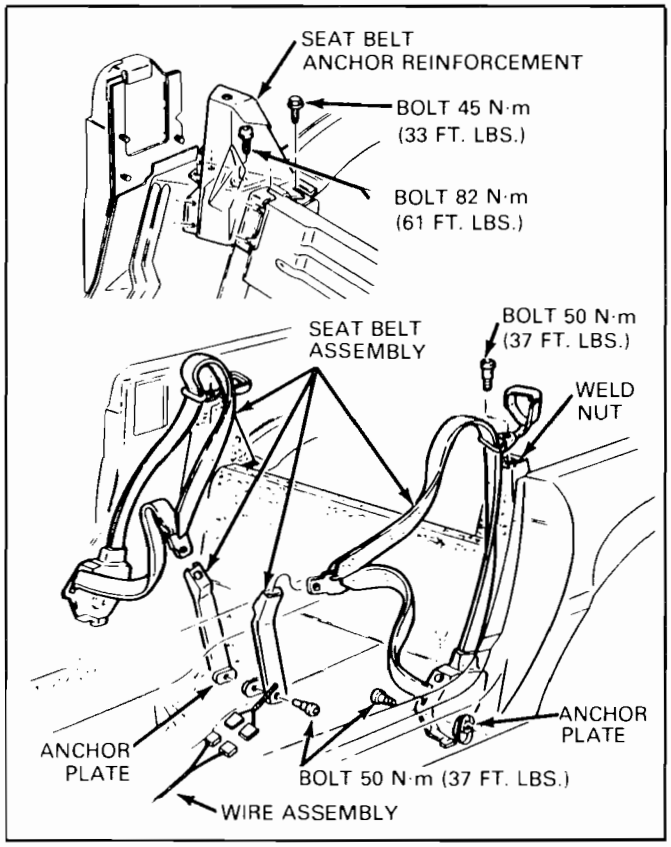


Figure 10-32B Seat Belt and Should Harness (Convertible)

SEAT BELT AND SHOULDER HARNESS ASSEMBLY (FIGURE 10-32)

Removal

1. Remove seat assembly as previously described in this section.
2. Remove bolt retaining buckle end of lap belt and disconnect belt wiring.
3. Remove seat belt retaining bolt at floor side rail.
4. Remove shoulder belt retractor retaining bolt and remove belt assembly.

Installation

1. Install lap belt retractor assembly and retaining bolts.
2. Install shoulder belt retaining bolt at side rail.
3. Install buckle end of lap belt and retaining bolts. Connect belt wiring.
4. Install seat assembly.

BODY REPAIRS

PRECAUTIONS

Creams are available to protect the skin from a condition known as occupational, or contact dermatitis. Improved resin formulas have almost eliminated skin irritation. Creams are available for persons who may have a tendency toward skin irritation from the resins or dust.

The application of these creams is recommended whenever the resin materials are used. Generally the cream is not required when formulas are being used.

1. Apply protective cream as follows:
   a. Wash hands clean. Dry thoroughly.
   b. Squeeze about 1/2 inch (or 1/2 teaspoonful) of cream into palm of hand.
   c. Spread evenly and lightly until cream disappears. Work cream into cuticle, between fingers and wrists.
   d. Apply second coat, repeating Steps b and c.
   e. Hold hands briefly under cold running water to set cream.
2. Remove resin mixture from hands as soon as possible and always before mixture starts to gel. This can be observed by the action of the material being used. Resin may be removed with lacquer thinner by washing in soap and water.
3. Respirators are recommended when grinding. Some minor skin irritaion from glass and powdered cured resin may be evident. Washing in cold water will help to minimize irritation.
4. Use a belt sander with a vacuum attachment for dust control whenever possible.
5. Resin mixtures may produce toxic fumes and should be used in well ventilated areas.
6. Be careful not to get any resin material on clothing.
7. Use the proper materials for the job.
8. Keep materials, utensils and work area clean and dry. These repairs involve chemical reactions, and dirt or moisture may upset the chemical balances and produce unsatisfactory results.
9. Before starting repair operations, look for hidden damage by applying force around the damaged area, looking for hairline cracks and other breakage. Check for minor damage at other points in the vehicle such as around exhaust pipes, grille, headlamps and points of wear. Early repair or minor damage may prevent major repair later.

GENERAL INSTRUCTIONS

The following gives information necessary for repair of collision damage and performance of general maintenance on Corvette bodies. Included here is information dealing with availability of repair panels, general installation procedures for panels and repairing damage to the body.

Repair of fiber glass reinforced plastic bodies can be a relatively easy matter if precautions are observed.

In cases where welding must be done on steel parts which are installed on body, do not allow flame or welding heat to come into direct contact with plastic body panels. The general area around the welding operation should be protected with wet asbestos or any other like method (several thicknesses of aluminum foil makes an excellent heat shield if out of the way of direct flame).

Before cutting, drilling or performing any similar type operation, be sure to check rear side of where work is to be done. Make sure operation will not damage electrical wiring, electrical motors or other type of similar damage. A check should also be made to insure the contemplated repair will not interfere with and/or cause binding of any mechanical or electrical functions.

Straightening of steel parts while still in the body must be done with care. When applying hydraulic jacks or like equipment which operates by exerting force, bear in mind that the part being used to brace the stationary end of tool must be able to withstand such usage. Fiberglass parts will not yield or "take a set" as with steel parts, so they cannot be "straightened". If poor alignment exists due to collision or other physical damage, check steel reinforcements in cowl and sill areas with care.

Tracing line of damaging force and checking body carefully for broken bonds and cracks before, during and after repairs will pay off repeatedly.

Small cracks and faults in bonds and panels will usually grow larger if left unattended.

COSMETIC REPAIRS

Figure 10-33 illustrates various bonds which will be encountered during repair procedures. Cosmetic damage is a type of flaw in the body panel. It merely detracts from the appearance of the panel, but does not cause any actual physical damage, such as a loss of strength. Typically, these flaws are surface imperfections, such as, scratches or chips that penetrate through the paint and perhaps only slightly into the fiberglass laminate.

One of the uses for the epoxy solder-adhesive is to repair this type of damage when a filler is needed to

establish the original contour. This material will provide an easy and lasting repair.

SPECIFIC COSMETIC REPAIRS

Scratches, pits and minor imperfections (Figures 10-34 and 10-35).

1. In many instances, a scratched panel will involve only a paint refinishing job. In cases where the panel has been scratched only to the fiberglass laminate, the following procedure should be used.
   a. Remove all paint down to the fiberglass laminate from areas surrounding scratch by sanding.
   b. Feather edge of repair area with No. 220 wet or dry sandpaper and finish block sand with No. 320 wet or dry sandpaper.

   CAUTION: Do not sand too deeply into fiberglass mat. Should it be necessary to cut fairly deep into the fiberglass mat, use the repair procedure suggested in Step 2 below.

   c. Clean up repair area using cleaning solvent. Finish cleanup with a tack rag.
   d. Protect surrounding panels by masking before performing paint refinishing operations. Use only non-staining type masking tape on Y Series fiberglass body.
   e. Refinish panel.
2. In some instances, the damaged area requires a plastic buildup to the original contour. When the fiberglass laminate is not pierced through or the damage extensive, the repair procedure is as follows.
   a. Remove paint down to the fiberglass laminate from area surrounding the damage by sanding.
   b. Grind or file to form a "V" at damaged area. Side of "V" should have a pitch for maximum bonding surface. A belt sander with a vacuum attachment will minimize the dust problem.
   c. Scuff sand area surrounding damaged area to provide a good bonding surface.
   d. Clean up work area with cleaning solvent. Use tack rag for finish cleanup.
   e. Mix the epoxy solder-adhesive resin and hardener using a one-to-one mixture.
   f. Apply the epoxy solder-adhesive using a putty knife or rubber squeege (Figure 10-36).
   g. Apply heat to repair area (Figure 10-37). Heat lamps are recommended to be used at least 12 inches away from repair. Allow at least one hour curing time. If heat lamp is not available, allow to cure at room temperature 70° to 75°F (21°C to 24°C) for 8 to 10 hours.
   h. Finish the repair by grinding, sanding and painting in the usual manner.

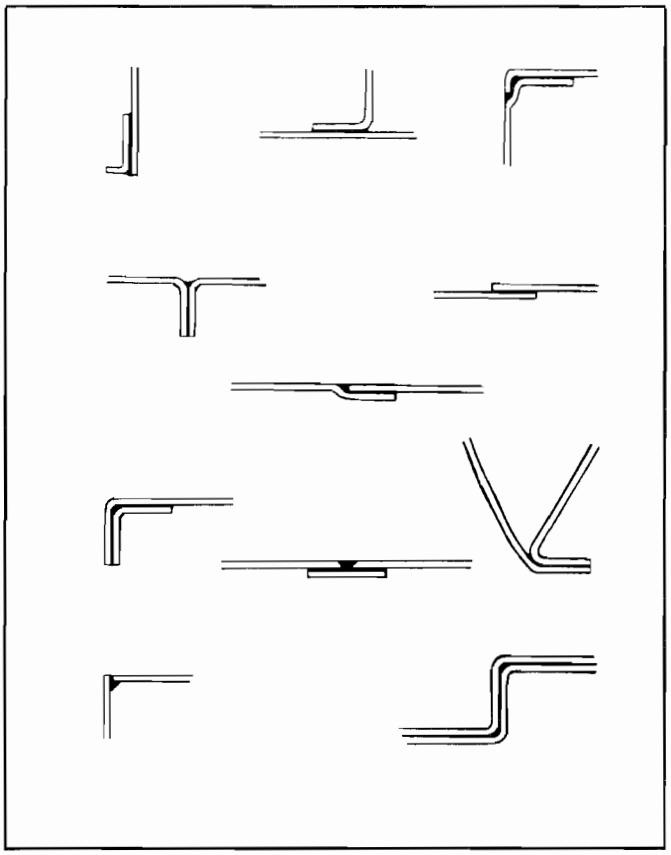


Figure 10-33 Typical Body Bonds

STRUCTURAL REPAIRS

Damage to body panels such as cracks or holes that pass completely through the thickness of the fiberglass laminate are known as structural damage. This type of damage can affect the strength and structural soundness of the laminate. All structural repairs, require the use of backing strips or backing patches to provide the mechanical strength needed to keep a repair structurally and visually intact during normal usage. The patch also provides the required foundation to build and form the exterior surface to match the original contour.

Typically, the backing patch is simply layers of glass cloth applied to the back side of the damage using a mixture of liquid epoxy resin and hardener. These materials (resin, hardener and cloth), along with protection cream and mixing utensils are found in the epoxy resin repair kit.

SPECIFIC STRUCTURAL REPAIRS

Cracks or Holes With Rear of Panel Accessible

1. Look for hidden damage. Apply force by hand around damaged area.
2. Sand off finish from around damaged area. Inspect area again for signs of other damage.
3. Using a grinder, file or hacksaw blade, form a "V" at damaged area (Figure 10-38). Side of "V" should have a shallow pitch for maximum bonding surface. A belt sander with a vacuum attachment will minimize the dust problem. Be sure to remove all damaged material. Scuff sand

area surrounding damaged area to provide a good bonding surface.

4. Clean back side of damaged area to provide a good bonding surface for the backing patch. Use sandpaper or grinder, and cleaning solvent. Cleaning solvent should not leave any deposit on bonding surface. Use VMP or high flash naptha or equivalent.
5. Align panel portions, if necessary, to establish the original panel profile (Figure 10-39). When available, a scrap piece of fiberglass conforming to the general contour of the damaged area may be used as a backing patch in place of the glass cloth and liquid resin laminate described in Steps 6 through 8 below. In these cases, the plastic patch should overlap the damaged area by at least 2 inches on all sides and be attached to the rear side of the hole or crack, using the epoxy solder-adhesive as an adhesive. Surface preparation in either case is identical.
6. Cut fiberglass cloth to size, allowing at least 2 inches overlap on all sides of damage.
7. Mix liquid resin and hardener, 1 part hardener to 4 parts resin.

CAUTION: Cleanliness is most important. Be sure all containers are dry and clean and the resin and hardener cans are kept closed when not in use. Do not use waxed cups for mixing and do not allow resin to enter hardener can or vice versa.

8. Saturate 3 to 5 layers of fiberglass cloth with the liquid resin mixture. Place laminate (1 layer at a time) over rear of damage area. Smooth out wrinkles and make sure general contour of the area is maintained.
9. Apply heat to the backing patch area. Heat lamps are recommended to be used at least 12 inches away from repair. Allow at least one hour curing time. If heat lamp is not available; allow to cure at room temperature (70°-75°) for 8 to 10 hours.
10. After the backing patch is fully cured, fill exterior side of damage using the same procedure as for repair of cosmetic damage. Use of the epoxy solder-adhesive is recommended.
11. Finish the repair by grinding, sanding and painting in the usual manner.

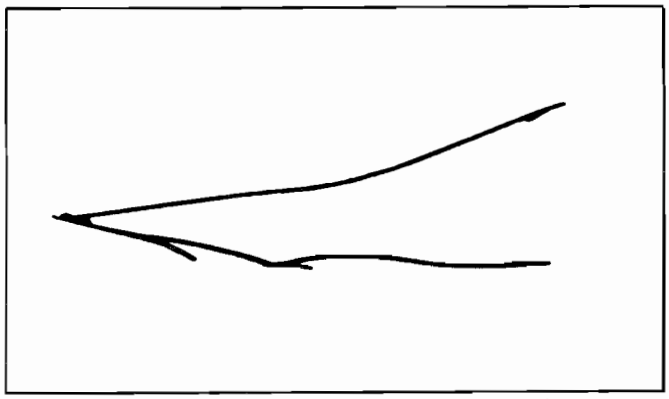


Figure 10-34 Typical Scratched Panel

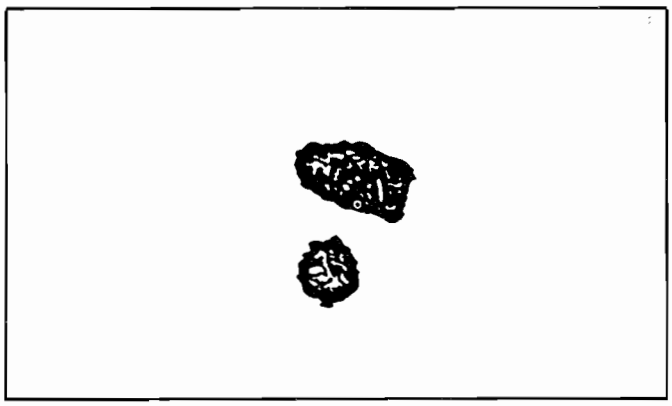


Figure 10-35 Typical Pitted Panel

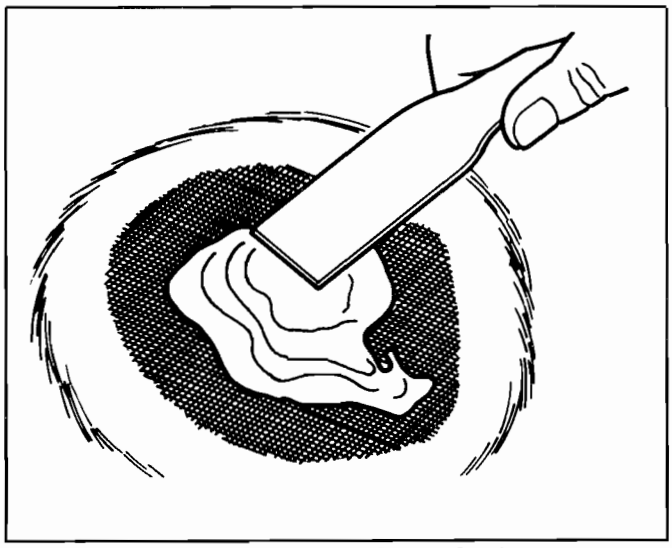


Figure 36 Applying Epoxy Solder

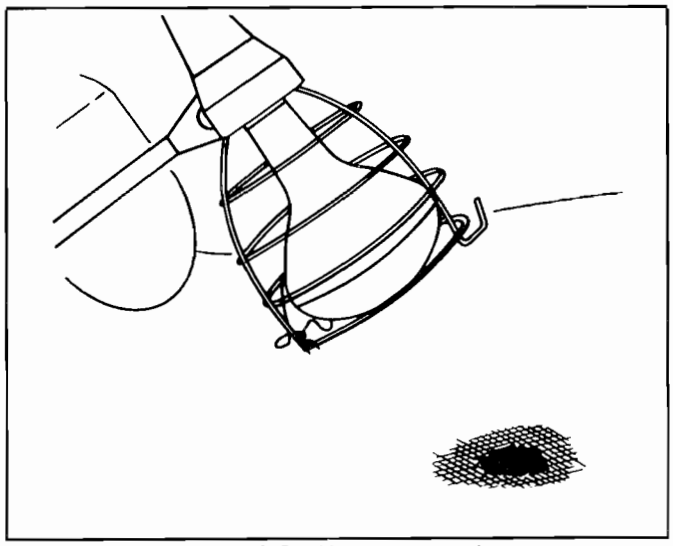


Figure 10-37 Heat Application

Cracks or Holes With Rear of Panel Not Accessible

1. Look for hidden damage. Apply force by hand around damage area.
2. Sand off finish from around damaged area. Inspect area again for signs of other damage.

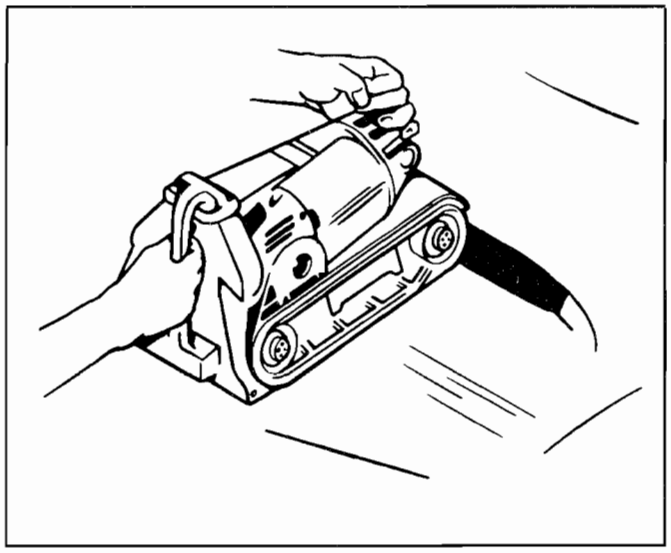


Figure 10-38 Grinding "V" at Damaged Area

3. Using a file or hacksaw blade, remove all damaged material until a hole is formed through which you can slip a backing patch.

   When available, a scrap piece of fiberglass conforming to the general contour of the damaged area may be used as a backing patch in place of the glass cloth and liquid resin laminate described in Steps 4 through 10 below. In these cases, the plastic patch should overlap the damaged area by at least 2 inches on all sides and be attached to the rear side of the hole or crack, using the epoxy solder-adhesive. Surface preparation in either case is identical.
4. Cut a piece of polyethylene film material, such as that used in wrapping food, large enough to extend approximately 3 inches beyond the edge of the repair area. Tape the film to the outside repair surface (Figure 10-40).
5. Cut fiberglass cloth to size, allowing at least 2 inches overlap on all sides of damage.
6. Mix liquid resin and hardener, 1 part hardener to 4 parts resin.

   CAUTION: Cleanliness is most important. Be sure all containers are dry and clean and the resin and hardener cans are kept closed when not in use. Do not use waxed caps for mixing and do not allow resin to enter hardener can or vice versa.
7. Saturate 3 to 5 layers of fiberglass with the liquid resin mixture. Place laminate (one layer at a time) over polyethylene film. Smooth out wrinkles, and make sure general contour of area is maintained (Figure 10-41).
8. Apply heat to the patch area. Heat lamps are recommended, set up at least 12 inches away from repair. Allow at least one hour curing time. If heat lamp is not available, allow to cure at room temperature 70° to 75°F (21 to 24°C) for 8 to 10 hours.
9. Allow patch to harden, then pop it off and remove the polyethylene.
10. Cut backing patch to desired size and shape. Patch should overlap damaged area by at least 2 inches on all sides. It may be necessary to layer epoxy and glass mat in patches to help reinforce epoxy material.
11. Sand the mating surface of backing patch to provide a rough bonding surface.
12. Using a grinder, file or hacksaw blade, form a "V" at the damaged area (Figure 10-42). Side of "V" should have a shallow pitch for maximum bonding surface. A belt sander with a vacuum attachment will minimize the dust problem. Be sure to remove all damaged material. Scuff sand area surrounding damaged area to provide a good bonding surface (Figure 10-43).
13. Reaching through the hole, sand underside of repair area with sandpaper to create a rough bonding surface approximately 2 inches from edges of repair area (Figure 10-44).
14. Drill two holes in backing patch approximately 3/4 inch apart. Thread a piece of waxed wire through the hole to assist holding patch in place after installation. Waxing wire will aid in removal later.
15. Mix bonding material and apply to mating surface of patch (Figure 10-45). Use of the epoxy solder-adhesive is recommended.
16. Slip patch through hole, then pull up hard on wires until adhesive squeezes out on all sides (Figure 10-46). Twist wires around a strip of wood to hold backing patch in position until adhesive set (Figure 10-47).
17. Apply heat to repair area. Heat lamps are recommended to be used at least 12 inches away from repair. Allow at least one hour curing time. If heat lamp is not available, allow to cure at room temperature 70 to 75°F (21 to 24°C) for 8 to 10 hours.
18. After backing patch is fully cured, fill exterior side of damage, using the same procedure as for repair of cosmetic damage. Use of the epoxy solder-adhesive is recommended. It may be necessary to layer epoxy and glass mat in patches to help reinforce epoxy material.
19. Finish the repair by grinding, sanding and painting in the usual manner.

Steel to Fiberglass Separations

Steel to fiberglass separations are joined with epoxy solder-adhesive after first cleaning out the old bond. Use mechanical attachment if necessary.

COMPLETE PANEL REPLACEMENT

In some cases damage to a body panel is so sever that re-establishing the original shape of the body using only resin, glass cloth and epoxy solder-adhesive is vitually impossible. In these instances, the use of replacement body panels is required.

Various repair panels are available for service. These complete panels may be used or sections may be cut to accommodate the type of repair necessary. The panels should be fitted in and mechanical attachments installed to insure proper alignment.

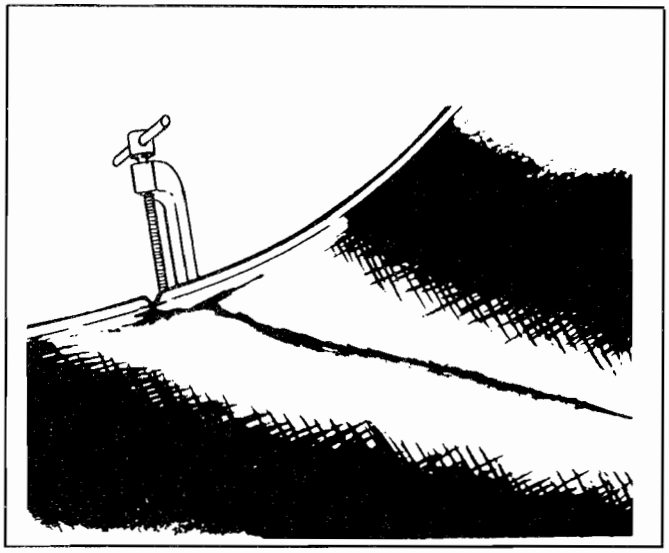


Figure 10-39 Cracked Panel Preparation

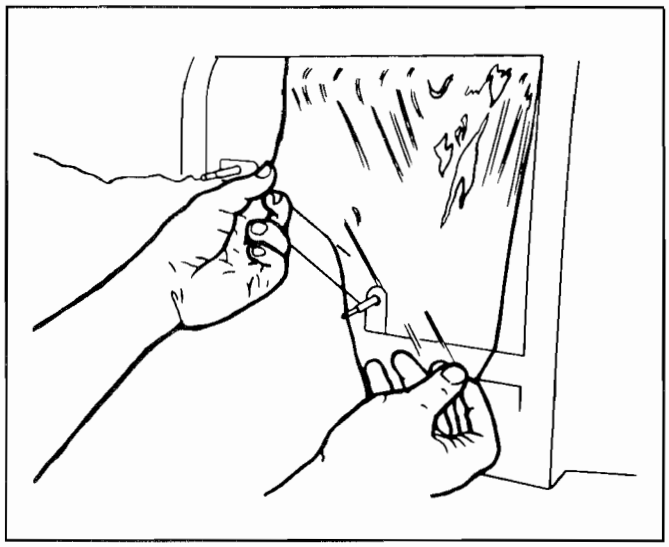


Figure 10-40 Applying Film Material

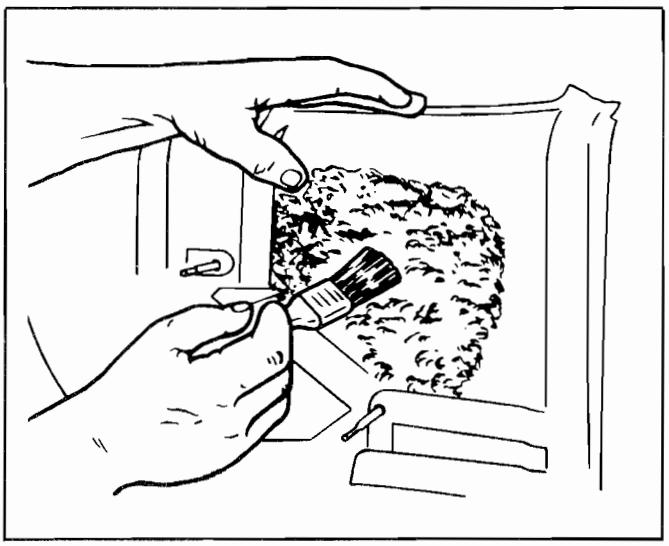


Figure 10-41 Forming the Patch

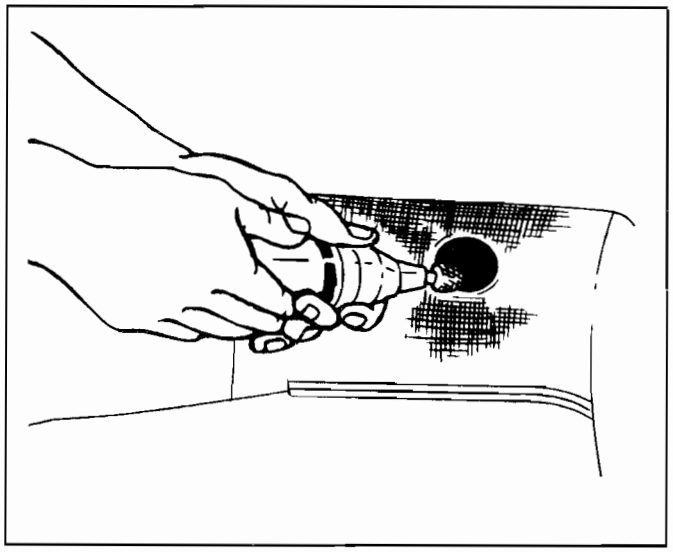


Figure 10-42 Forming "V" at Damage

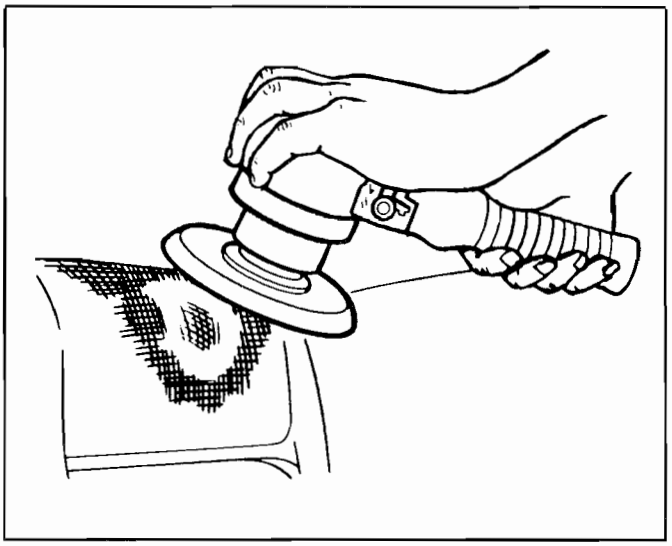


Figure 10-43 Scuff Sanding

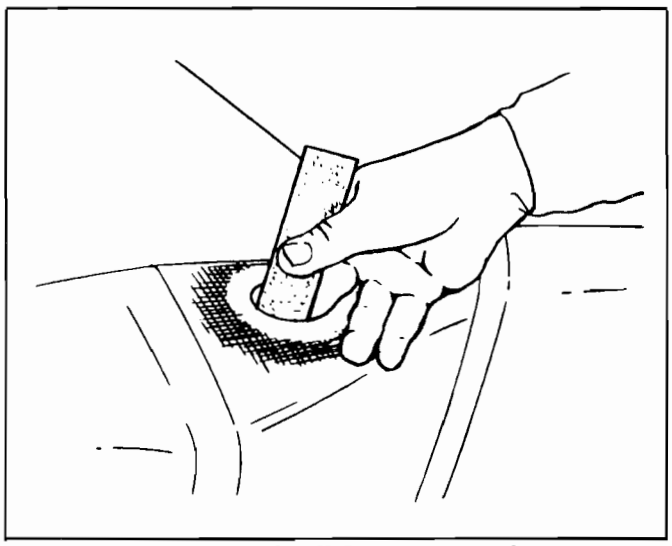


Figure 10-44 Scuff Sanding Rear Side

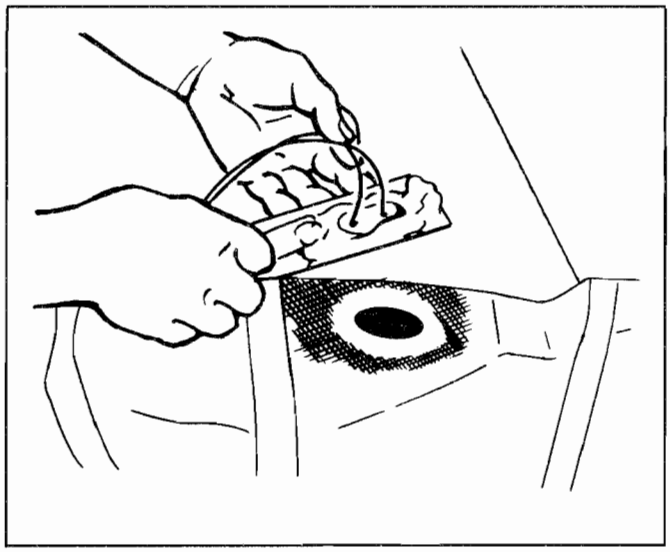


Figure 10-45 Applying Epoxy Solder

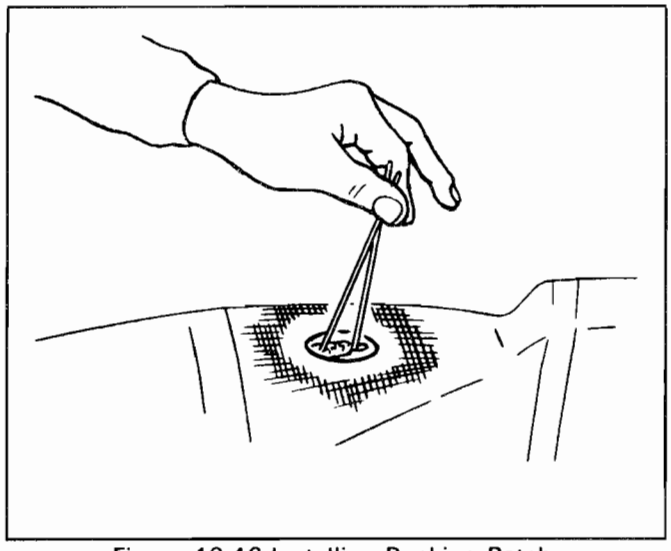


Figure 10-46 Installing Backing Patch

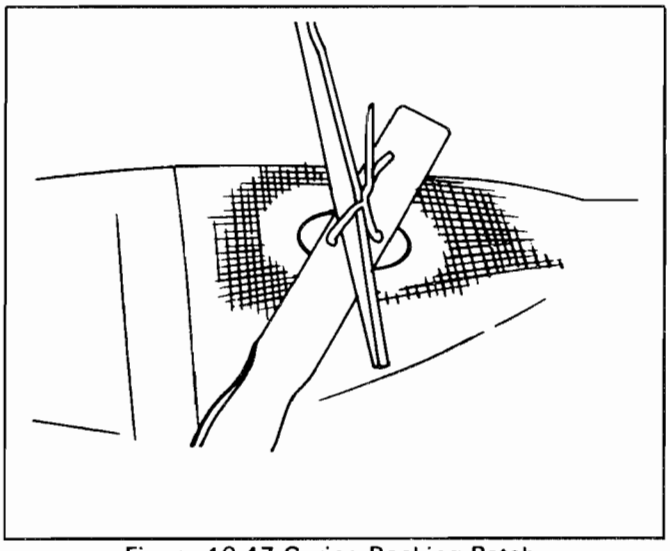


Figure 10-47 Curing Backing Patch

PARTIAL PANEL REPLACEMENT

Sometimes damage occurs which is severe, but does not warrant the replacement of an entire body panel. In these cases a replacement panel can be purchased, cut and bonded to the undamaged portion of the existing panel.

1. Remove the damaged portion of the body panel.
2. Cut appropriate portion or portions from replacement panel.
3. Scuff sand front surfaces on both the replacement panel and adjacent panel for a distance of 2 to 3 inches from attaching line. Scuff sand exposed bonding strip surface and mating surface on rear side of replacement panel using 60E grit sandpaper. Wipe all surfaces clean with cleaning solvent.
4. Bevel attaching edges at approximately 30° across entire thickness of the plastic so a single "V" butt joint will be formed on the finish surface when the pieces are jointed. If the replacement panel does not fit closely to the break, grind or cut edge to suit.
5. In areas where a production bonding strip is exposed bond replacement piece to the strip as specified in Complete Panel Replaccement Section above.
6. In areas where a production bonding strip is not exposed, attach the replacement piece to the undamaged portion of existing panel as specified in the Structural Repair Section.

NOTICE: In these cases, the gap between the existing panel and replacement piece can be thought of as a crack and be repaired as such by following procedures specified in structural repair.

7. Apply heat to repair area. Heat lamps are recommended to be used at least 12 inches away from repair. Allow at least one hour curing time. If heat lamp is not available, allow to cure at room temperature 70 to 75°F (21° to 24°C) for 8 to 10 hours.
8. After the bonding materials have fully cured, fill the exterior side of the damage, using the same procedure as for repair of cosmetic damage. Use of the epoxy solder-adhesive is recommended.
9. Finish the repair by grinding, sanding and painting in the usual manner.

ROOF PANEL (FIGURE 10-48)

Removal

1. Lower both side windows and move sunvisor out of the way to access front bolts.
2. Locate tool from console glove compartment.
3. Use the tool to loosen the four non-removable bolts (two near the rear corners in the roof panel and two in the brackets of the front corner molding). Turn each bolt counterclockwise; the bolts are designed to stay in place when loosened.
4. Remove roof panel.

Installation

Reverse removal procedure.

HATCH ROOF ASSEMBLY (FIGURE 10-48)

Replace

1. Remove roof panel as previously described.
2. Remove roof trim panel.
3. Remove molding.
4. Remove weatherstrip and retainer.

To install, clean up adhesive and reverse removal procedure.

HATCH ROOF LATCH/LOCATOR OR BRACKET (FIGURE 10-48)

Latch/Locator

Replace

1. Remove roof panel.
2. Remove locator assembly attaching (2) screws and shims from vehicle.

Bracket Assembly

1. Remove roof panel.
2. Remove center roof interior trim.
3. Remove bracket (2) screws and shims from vehicle.

To install, reverse removal procedure.

ROOF PANEL STORAGE BRACKET AND COVER

Replace

1. Open rear compartment hatch.
2. Remove (2) screws and cover.
3. Remove (2) nuts and brackets.

To install, reverse removal procedure.

ROOF PANEL LATCH ASSEMBLY AND REAR BRACKET

Replace

1. Partially remove right and left rear compartment opening trim.
2. Remove center trim.
3. Remove roof panel retaining latch.
4. Remove bracket (disconnect relay attached).

REAR WINDOW GLASS (FIGURE 10-50)

NOTICE: Rear Window upper hinge and glass are serviced as an assembly.

Replace

1. Disconnect battery ground cable.
2. Open rear hatch window.
3. Remove roof panel.
4. Remove interior center roof trim panel.

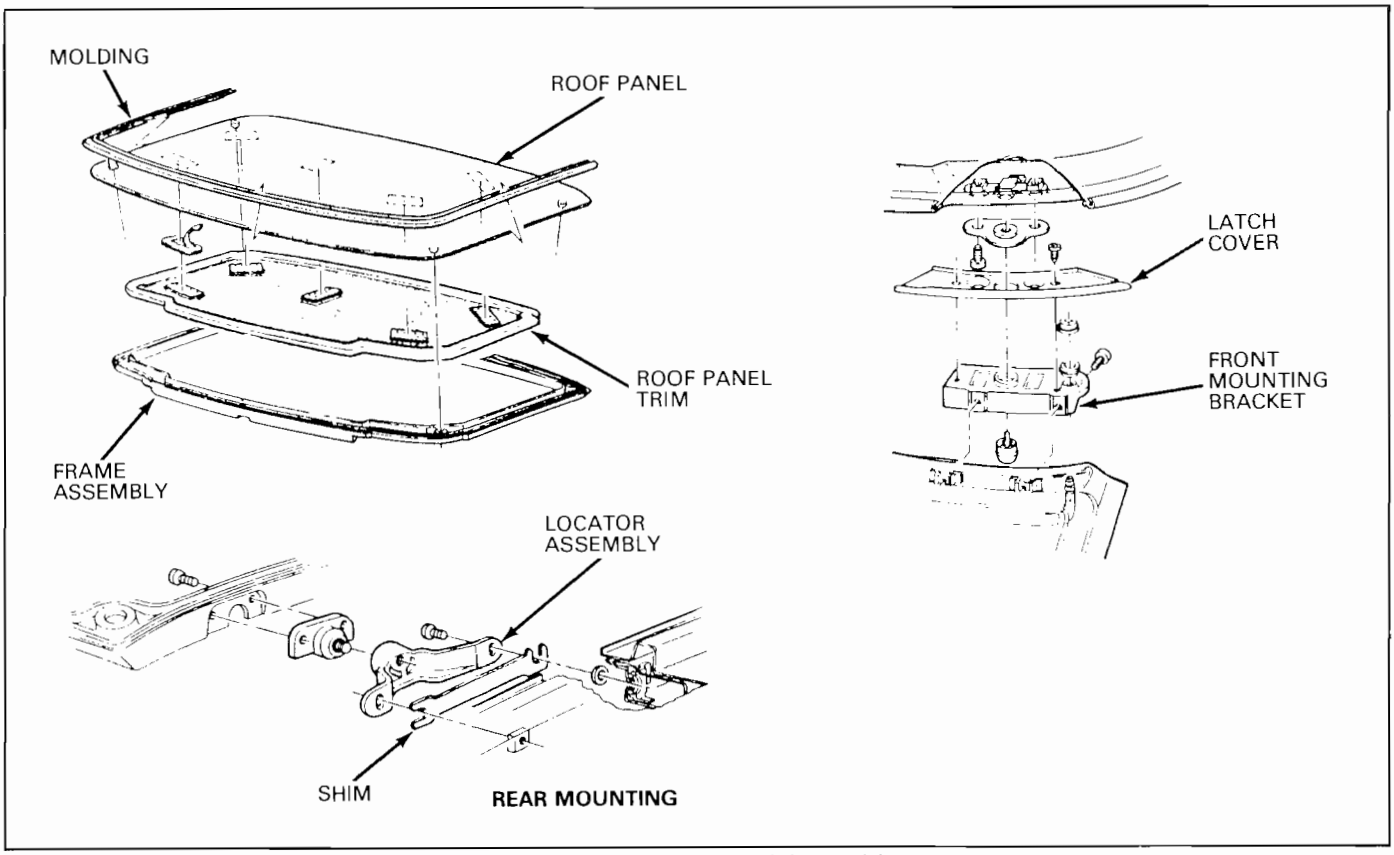


Figure 10-48 Roof Panel Assembly

5. Peel back (both sides at glass attachment access holes) and replace noise control patch. Disconnect ground connector for electric rear defogger.
6. Remove nut attaching rod at glass hinge and remove glass with helper.
7. Transfer striker to replacement glass on bench. On installation, adjust strike and rods as necessary.

REAR COMPARTMENT LID LOCK (FIGURE 10-50)

1. Remove back glass center garnish molding. (Loosen hatch opening side garnish moldings as necesary).
2. Remove roof panel storage bracket.
3. Remove lock assembly.
4. Reverse removal procedure to install lock. Adjust as necessary.

CENTER HIGH MOUNTED STOP LAMP

Bulb Replacement - Coupe

Figure 10-49

1. Open rear compartment lid.
2. Remove attaching screws.
3. Turn center high mounted stop lamp assembly over.
4. Remove screws holding lens assembly in place.
5. Pull bulb(s) from socket.

Installation

1. Install new bulb(s).
2. Reverse removal procedures to install lamp assembly.
3. Check operation.

CENTER HIGH MOUNTED STOP LAMP (FIGURE 10-49)

Removal - Coupe

1. Open rear compartment lid.
2. Remove attaching screws.
3. Partially remove headlining to expose wiring, wiring retainer nuts, and connector.
4. Disconnect wiring at connector.
5. Remove wiring retainer nuts.

Installation

1. Reverse removal procedures to install.
2. Check operation.

Removal - Convertible

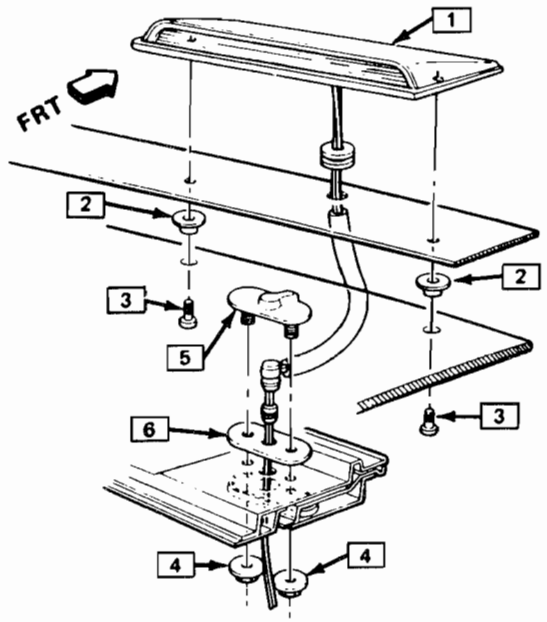
1. Remove fuel tank filler door assembly.
2. Remove fuel tank filler cap.
3. Remove fuel tank filler housing and drain hose.
4. Install fuel tank filler cap.
5. Remove license plate.
6. Remove two 10mm stamped nuts through upper body panel.
7. Lower lamp assembly and remove through license plate opening.
8. Disconnect electrical connector.
9. Remove screws from back of lamp assembly.
10. Push rubber grommet into housing.
11. Change bulb.

Installation

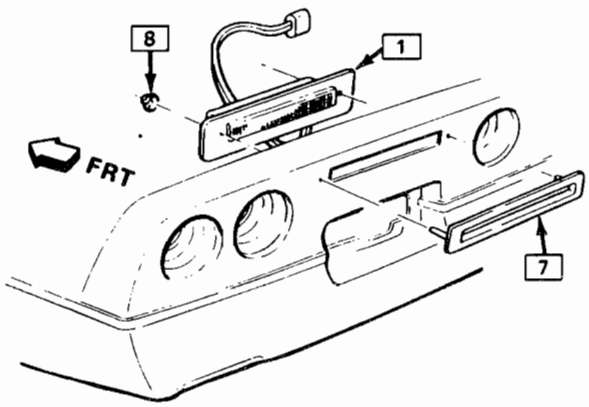
1. Reverse removal procedure.
2. Check operation.

WINDSHIELD WIPERS

The Corvette pulse windshield wiper and washer system consists of a permanent magnet depressed park



— COUPE —



— CONVERTIBLE —

1	LAMP ASSEMBLY	5	RETAINER
2	SPACER	6	GASKET
3	BOLT/SCREW 25 N·m (18 FT. LBS.)	7	BEZEL
4	NUT 10 N·m (7 FT. LBS.)	8	NUT

Figure 10-49 Center High Mounted Stop Lamp Assembly (Coupe/Convertible)

pulse wiper, a washer pump mounted under the washer bottle and a wiper switch mounted in the driver side door.

The pulse and timing functions, along with the program and demand wash functions, are controlled by a printed circuit board permanently attached to the wiper cover.

See Section 8E, Windshield Wiper Systems, for electrical troubleshooting and diagnosis of the wiper system.

WIPER ARM (FIGURE 10-52)

Removal

1. Remove washer hoses at connectors.
2. Pull wiper arm away from glass (allows retainer to be moved).
3. Pull retainer away from transmission spindle and pull wiper arm off of spindle.

Installation

1. Cycle wipers once and allow to park.
2. Install wiper arms in correct position.
3. Install washer hoses.

NOTICE: Sweep pattern must be checked on wet glass only in order to prevent damage to blade element or scratching of the glass, see Figure 10-53. The right wiper arm will not fully park when glass is dry and will show above the hood line. This is considered normal.

WIPER MOTOR (FIGURE 10-54)

Removal

1. Open hood.
2. Disconnect battery.
3. Remove driver's side wiper arm, see Wiper Arm Removal.
4. Remove cowl vent grill.
5. Remove nut from crank arm.
6. Remove crank arm from wiper motor.
7. Disconnect upper electrical connectors from wiper motor.
8. Remove wiper motor mounting bolts.
9. Remove wiper motor from cowl.
10. Disconnect lower wiper motor electrical connector.

Installation

1. Reverse removal procedure to install.
2. Check wiper operation.

WIPER TRANSMISSION (FIGURE 10-55)

Removal

1. Open hood and install fender covers.
2. Remove wiper arms.
3. Remove cowl vent grille.
4. Remove drive link from crank arm.
5. Remove transmission to cowl panel screws.
6. Remove transmission assembly through cowl vent grille opening.

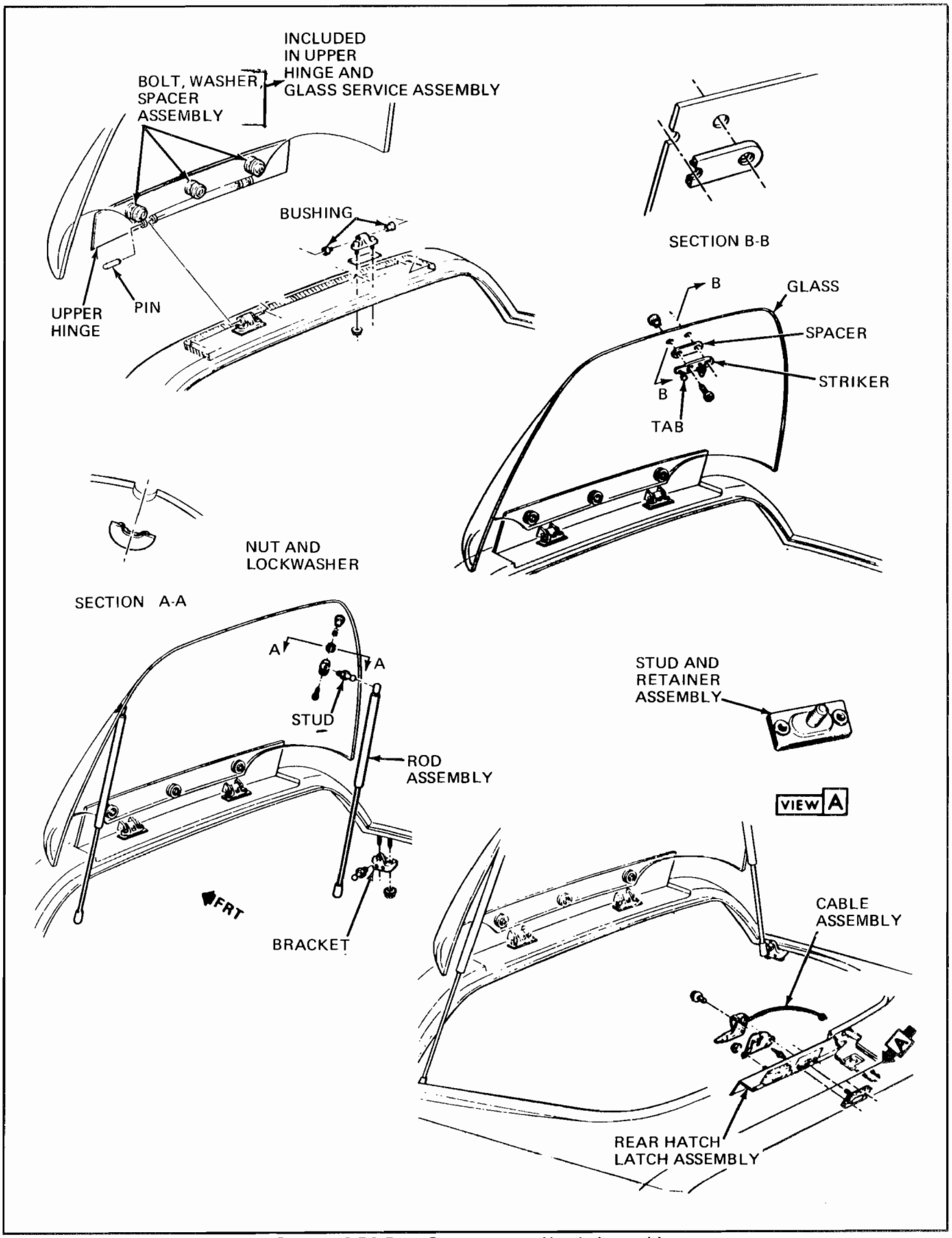


Figure 10-50 Rear Compartment Hatch Assembly

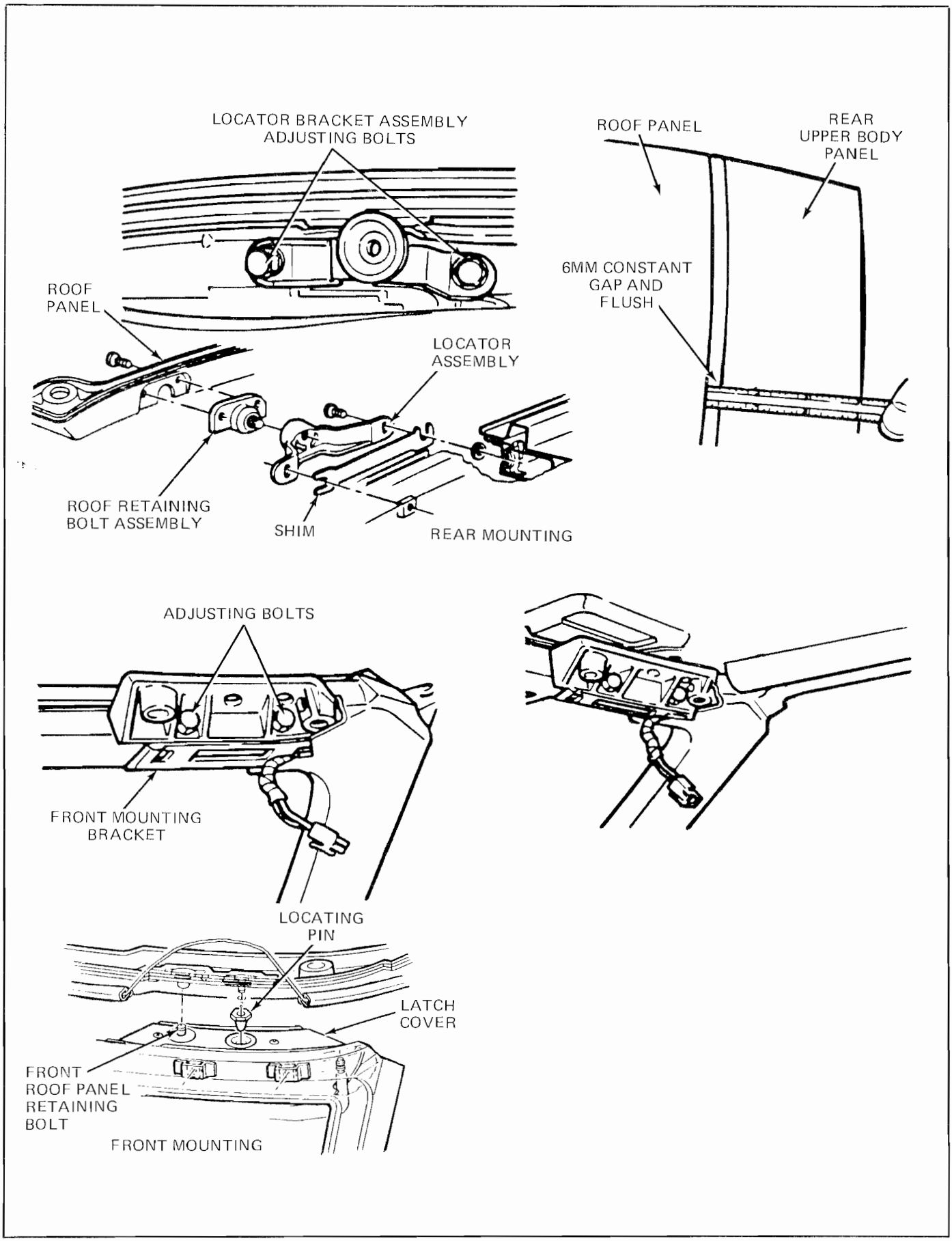
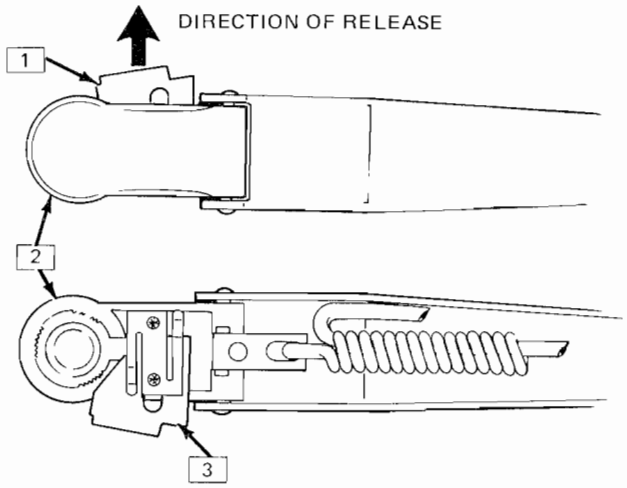
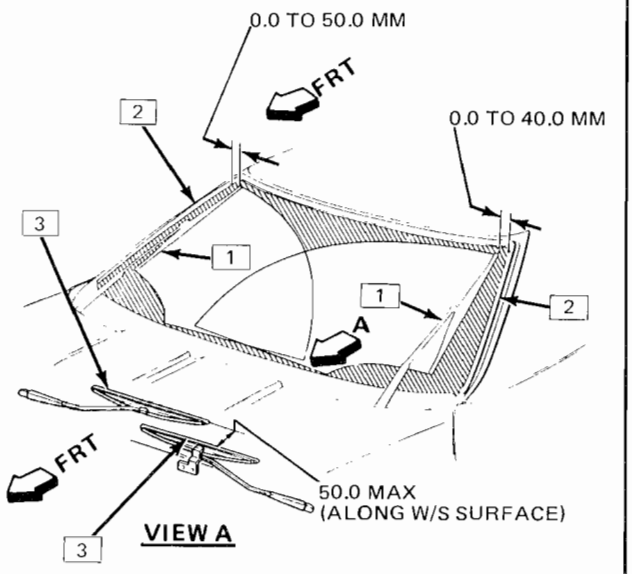


Figure 10-51 Corvette Roof Panel Adjustment Points



1. WIPER ARM RETAINER (RELEASED POSITION)
2. WIPER ARM ASSEMBLY
3. RETAINER SHOWN FROM UNDERSIDE (RELEASED POSITION)

Figure 10-52 Wiper Arm Removal



1. WIPER ARM ASM.
2. WINDSHIELD REVEAL MOLDING
3. BLADE ASM.

Figure 10-53 Wiper Blade Sweep Pattern Specifications

Installation

1. Reverse removal procedure to install.
   - Adjust wiper arms as required at transmission socket, see Figure 10-54.

GLASS POLISHING

Removal of Minor Scratches and Abrasions

Minor glass scratches and abrasions on the outside surface of the glass can be removed or reduced by using the methods described in this section.

There are two basic types of auto glass: laminated safety plate (used in all windshields) and solid tempered safety plate (used in side and back windows).

A major concern in glass polishing is the chance of causing double vision in areas of occupant vision. For this reason, polishing of a windshield in the occupant's line of vision is more limited than in other areas. Distortion is most apt to result when trying to remove deep scratches. Glass polishing must be performed with care.

The items listed below are needed for glass polishing.

1. Low speed (600-1300 RPM) rotary polisher (Skil Model No. 570 or equivalent).
2. Wood felt rotary-type polishing pad, about 75mm (3 inches) in diameter and 51 mm (2 inches) thick.
3. Powdered cerium oxide (No. 14 Rareox or equivalent) mixed with water as the abrasive compound. Follow manufacturer's directions when using any type of polishing compound.
4. Wide mouth container to hold the polish.

Glass Polishing Procedure (Figure 10-56)

NOTICE: This operation must not be used on the inside of rear window glass which has heating elements in the glass because the heating elements will be damaged.

1. Mix two parts of polishing compound (No. 14 Rareox or equivalent) with one part water to obtain a creamy mixture.

2. Stir mixture now and then to maintain a creamy texture. Powdered cerium oxide is hard to mix with water and tends to separate.

3. Draw circle around scratches on opposite side of glass with a wax marking pencil or crayon. Draw other lines directly behind scratches to serve as guides in locating scratch during polishing.

4. Use masking paper where needed to catch drippings or spattered polish.

5. Dip felt pad attached to polisher into mixture several times to insure that pad is well saturated. Do not submerge or allow pad to stay in mixture as it may loosen bond between pad and metal plate.

6. Using moderate (but steady) pressure, hold pad flat against scratched area of glass, and with a feathering-out motion, polish affected area. Avoid heavy pressure. It does not speed up operation and may cause overheating of glass.

7. Cover enough area around scratch with a feathering-out motion to eliminate any chance of bull's-eye.

NOTICE: Do not hold tool in one spot or operate tool on the glass any longer than 30 to 45 seconds at a time. If glass becomes hot to touch, let it air

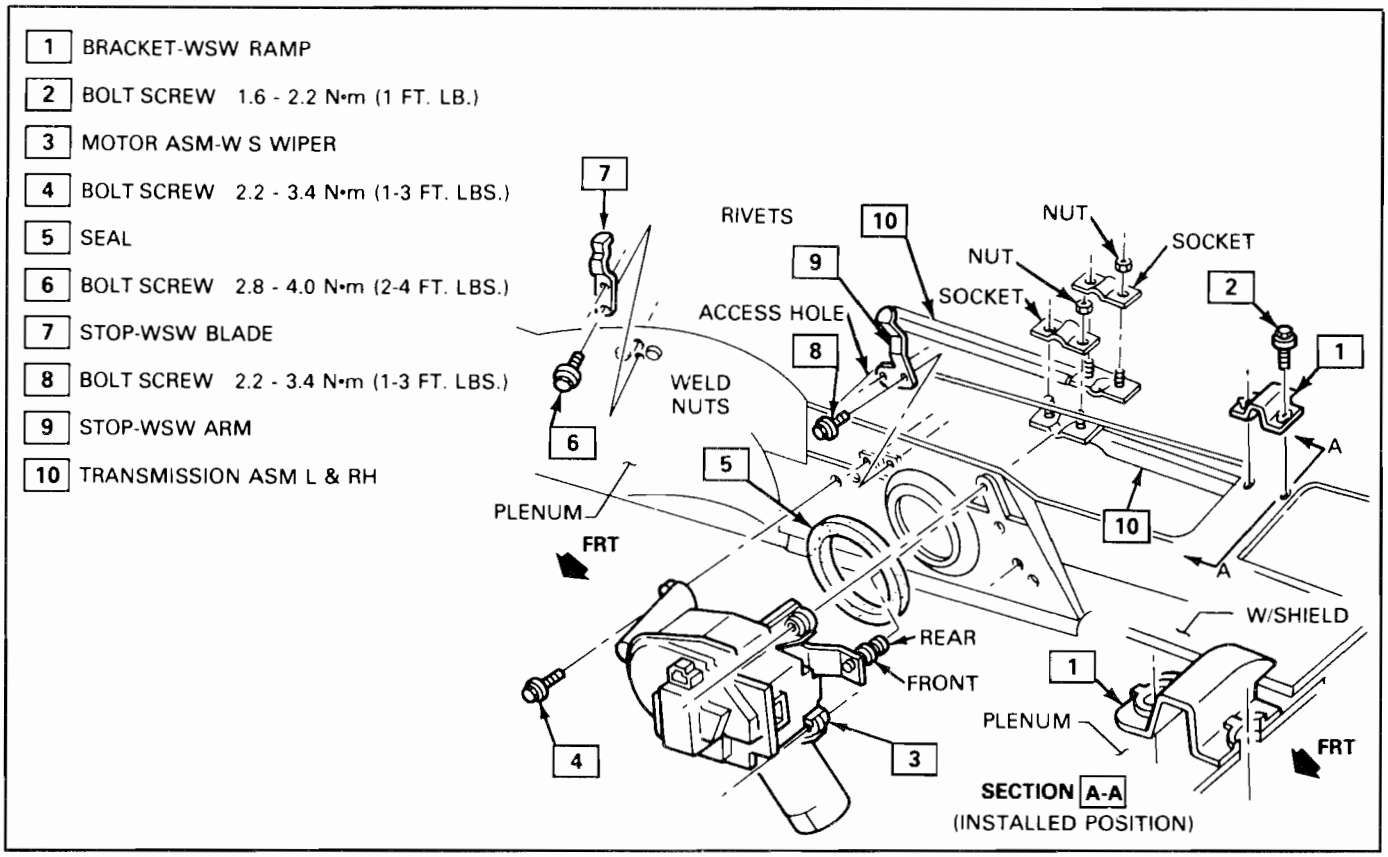
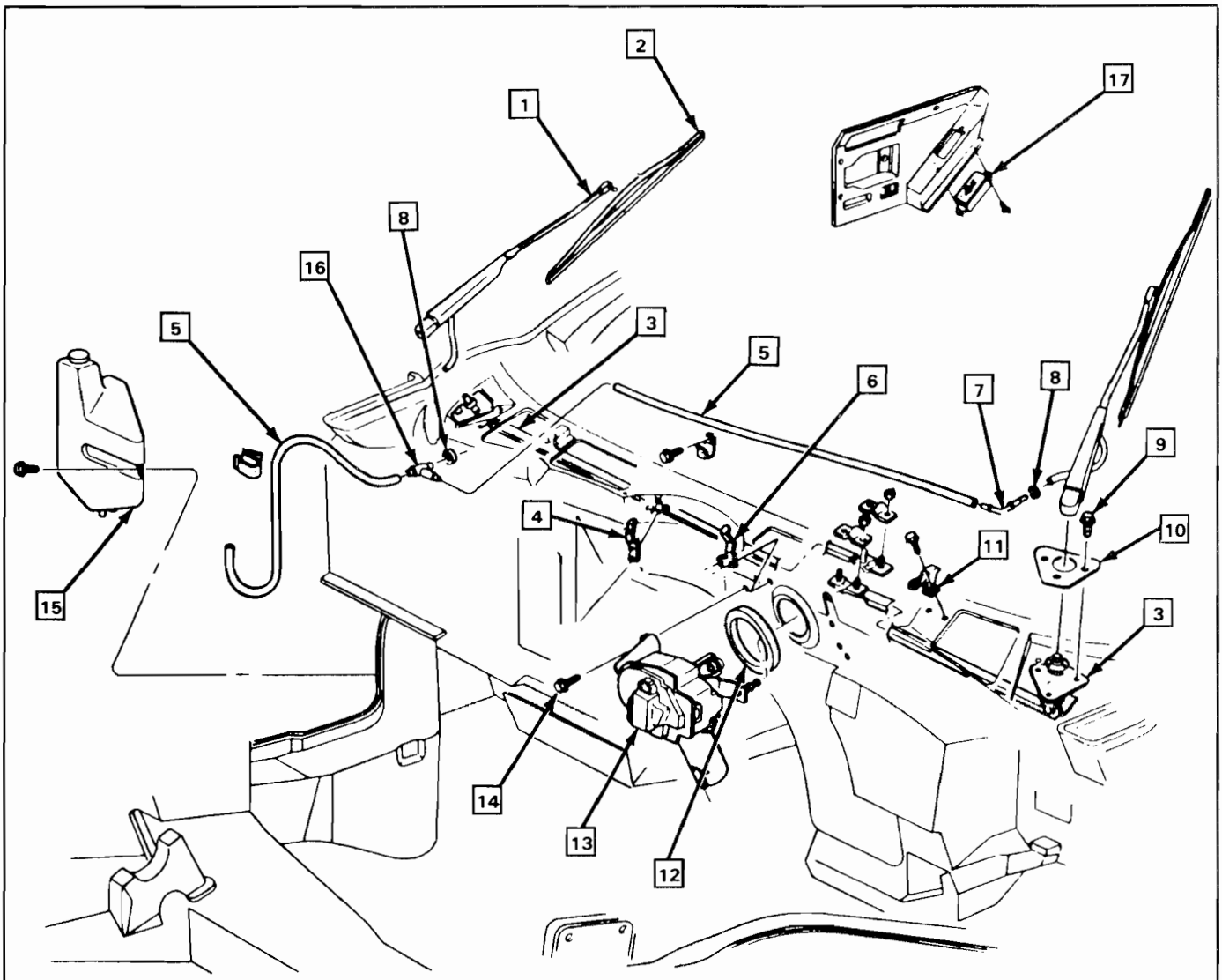


Figure 10-54 Wiper Motor

cool before proceeding further. Cooling with cold water may crack heated glass.

8. Dip pad into mixture about every fifteen seconds to insure that wheel and glass are always wet during polishing operation. A dry pad causes too much heat to build up.
9. After removing scratch or abrasion, wash glass with water and wipe body clean of any polish.
10. Clean polishing pad.

NOTICE: Care should be taken during polishing and storage to keep pad free of foreign material such as dirt, metal filing, etc.



1	WINDSHIELD WIPER ROD, LEFT AND RIGHT HAND	9	SCREW
2	WINDSHIELD WIPER BLADE	10	TRANSMISSION OUTER REINFORCEMENT
3	TRANSMISSION ASSEMBLY, LEFT AND RIGHT HAND	11	WINDSHIELD WIPER ARM PARK RAMP
4	WINDSHIELD WIPER BLADE STOP	12	GASKET (SEAL) MOTOR TO DASH PANEL
5	WINDSHIELD WASHER HOSE	13	WINDSHIELD WIPER MOTOR
6	WINDSHIELD WIPER ARM STOP	14	WINDSHIELD WIPER MOTOR BOLT
7	NOZZLE HOSE CONNECTOR	15	WASHER JAR
8	PUSH ON NUT	16	NOZZLE HOSE CONNECTOR TEE
		17	WINDSHIELD WASHER AND WIPER SWITCH

Figure 10-55 Wiper Transmission Assembly

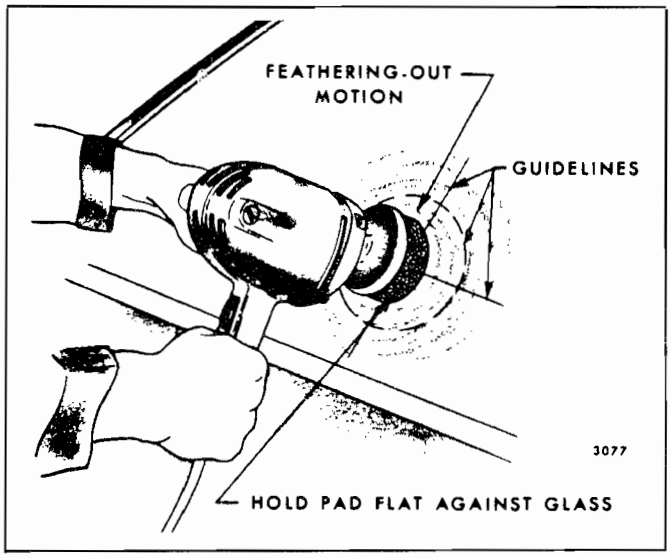


Figure 10-56 Minor Glass Scratch Removal

SPECIFICATIONS

CORVETTE BODY

	Torque
Door Hinge Attaching Bolts	20-34 N•m
Door Lock-Striker Bolt	50-70 N•m
Retractor Mounting Bolt-Shoulder Belt	40-60 N•m
Lap Belt Inboard Attachment	40-60 N•m
Shoulder Harness Attachment Bolt	40-60 N•m
Seat to Adjuster Screw	20-34 N•m
Seat Adjuster to Floor Nut	12-16 N•m

Figure 10-57 Specifications

SECTION 10A
CHILD RESTRAINT SEAT

CHILD RESTRAINT SEAT

Top Tether Anchor Assembly

Installation:

1. Remove rear floor carpet and insulator.
2. Drill a 9mm (11/32 inch) diameter hole through the floor at the location shown in Figure 10A-1.

   CAUTION: Double check hole location to avoid damage to the vehicle under-carraige components.
3. Reinstall insulator, cut 38mm (1-1/2 inch) diameter hole for washer/spacer*. Reinstall the carpet and cut a 9mm (11/32 inch) dia. hole for the anchor attaching bolt.
4. Using a suitable sealer, such as silicone or butyl type caulking, apply a bead of sealant around the 9mm (11/32 inch) drilled hole in the floor pan. The sealant is to be applied on the outer side of the floor pan (Figure 10A-2).
5. Install the tether anchor bracket, as shown in Figure 10A-2, and tighten nut securely.

NOTICE: In the event the tether anchor assembly is removed, the 9mm dia. hole must be properly resealed to prevent exhaust fumes from entering the vehicle.

* Washer/spacers (Not Supplied):
Three flat washers 32mm (1-1/4") x 3mm (1/8") thick, with a 9mm (11/32") dia. hole. Total stack-up of washer/spacer is to be 9.5mm (3/8").

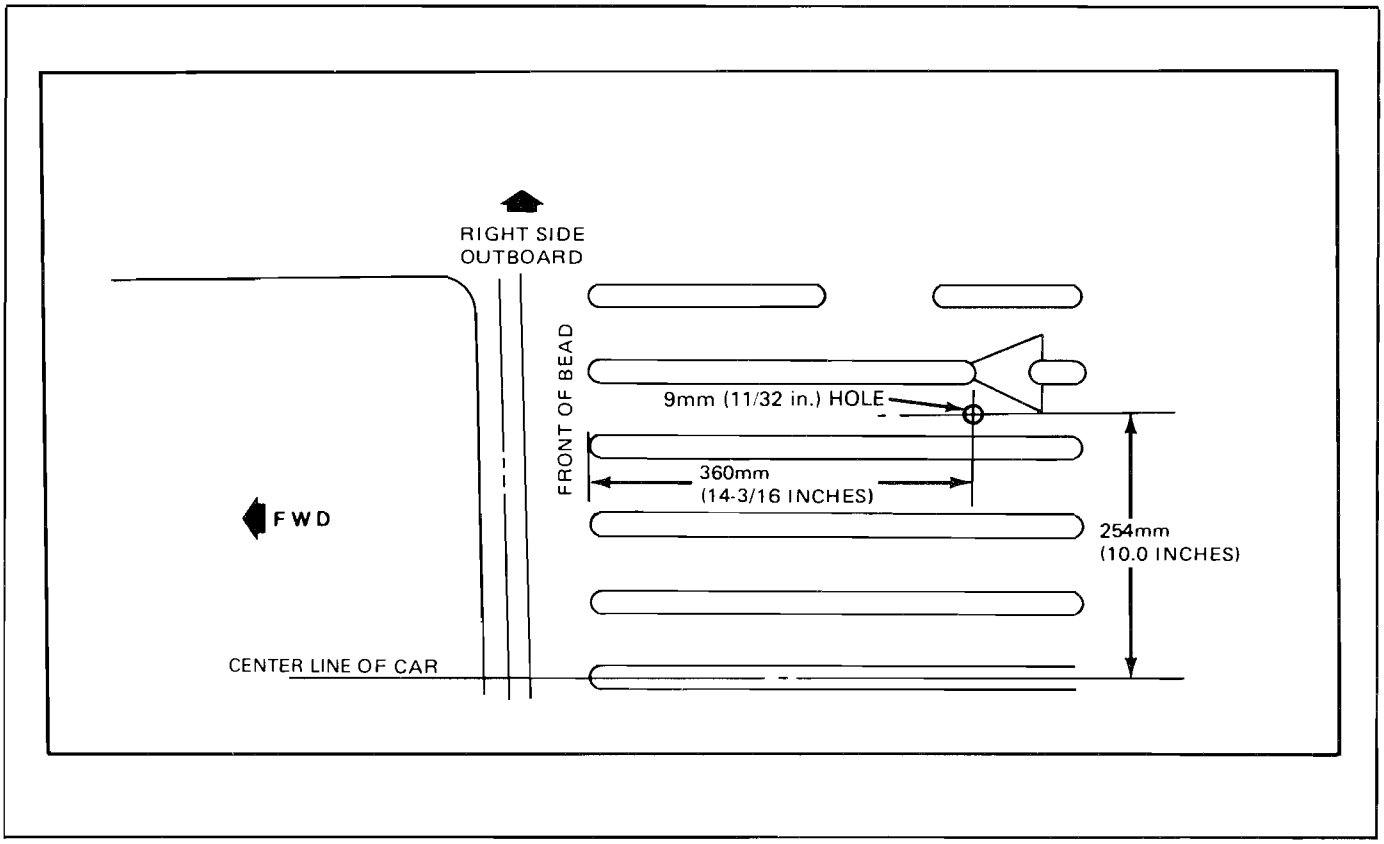


Figure 10A-1 Top Tether Anchor-Bolt Hole Location

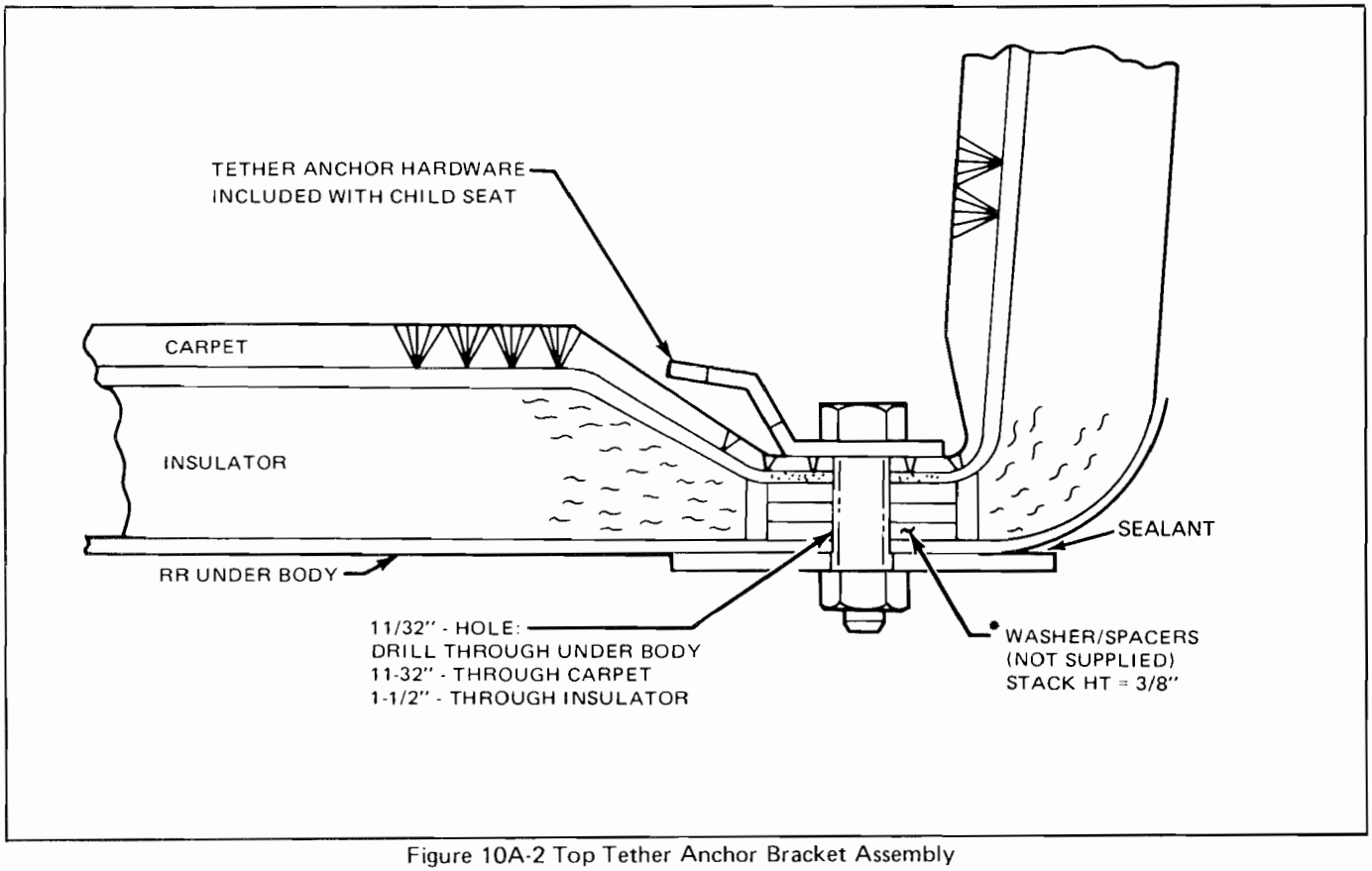


Figure 10A-2 Top Tether Anchor Bracket Assembly

SECTION 10B

WATERLEAK PREVENTION

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SEALING SYSTEM LAY-OUT

See Figure 10B-1

SEALING SYSTEM DESCRIPTION

The sealing system consists of the parts shown in Figure 10B-1. The weatherstrips are bonded to the retainers with weatherstrip adhesive. Sealing strips are

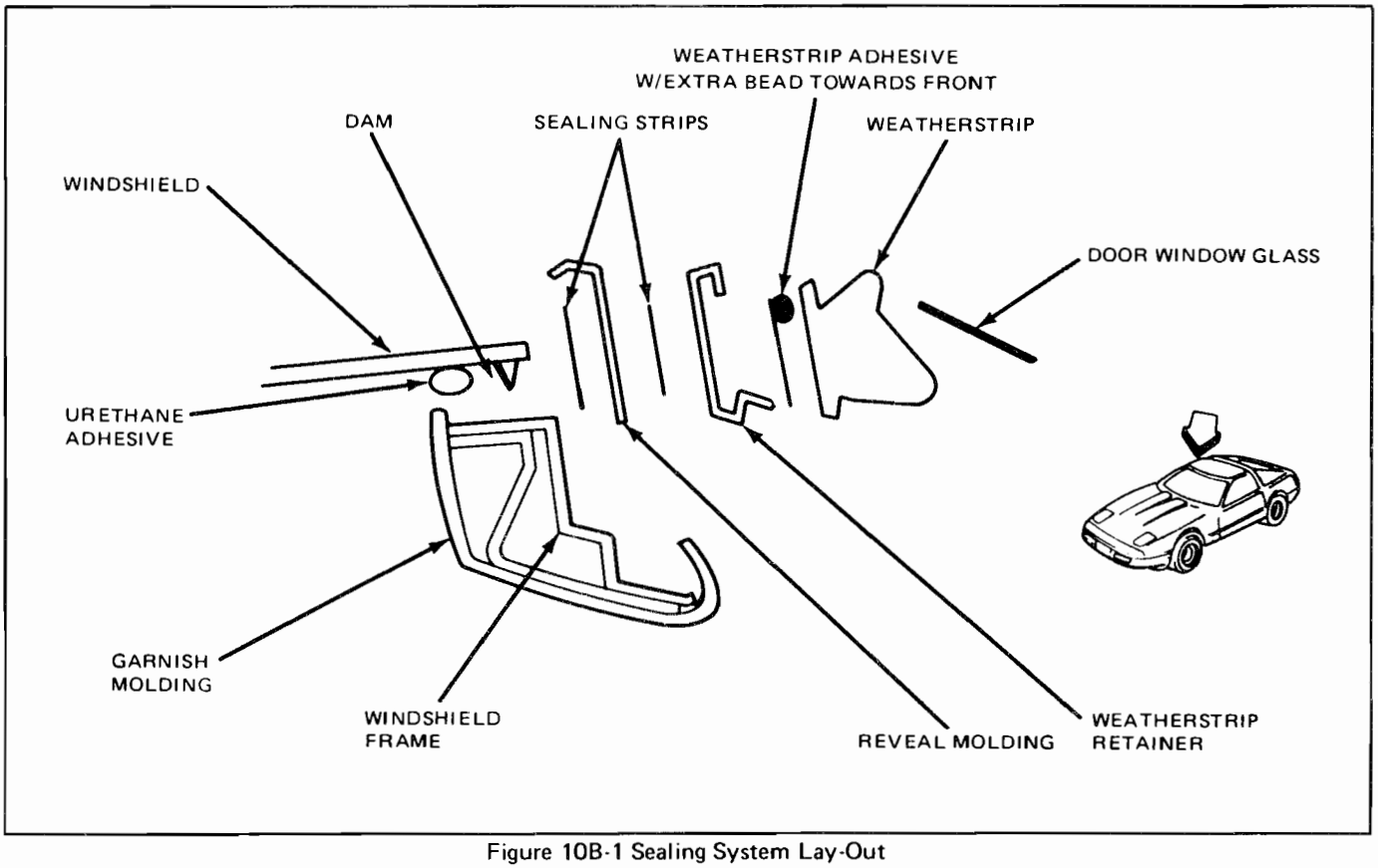


Figure 10B-1 Sealing System Lay-Out

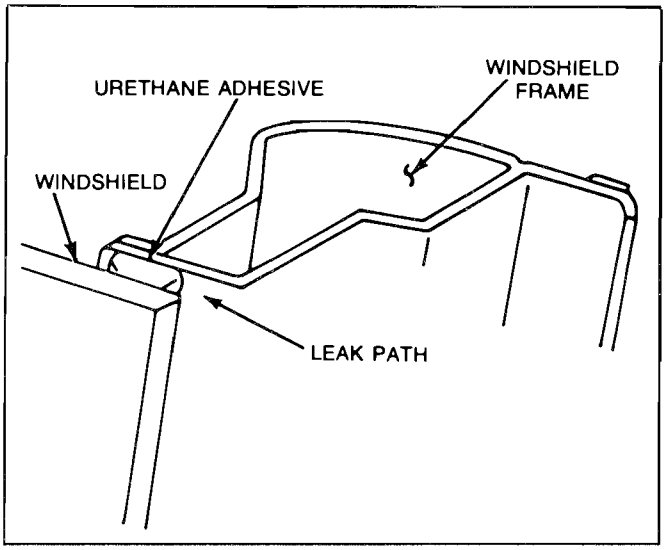


Figure 10B-2 Path 1

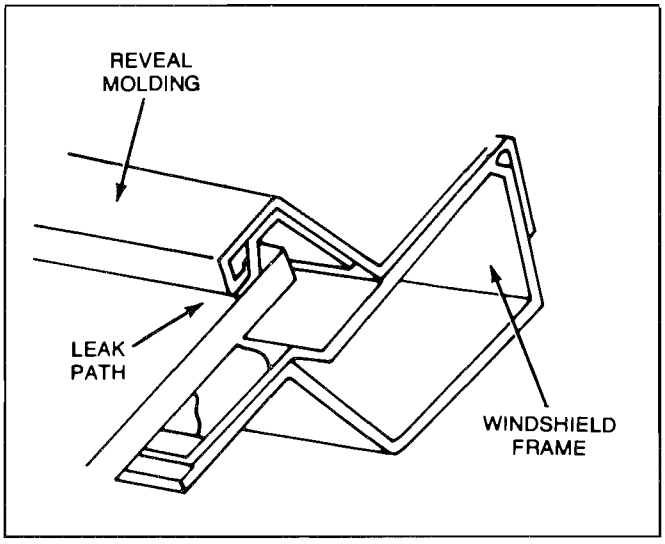


Figure 10B-3 Path 2

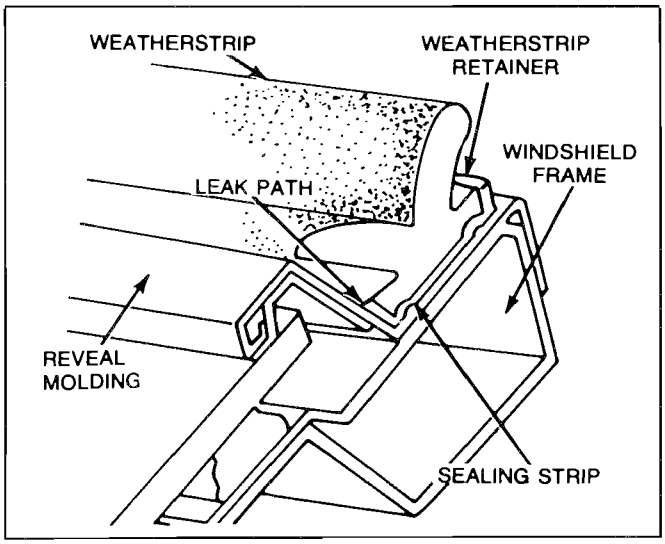


Figure 10B-4 Path 3

used between the retainers and the reveal moldings and the pillars in the windshield

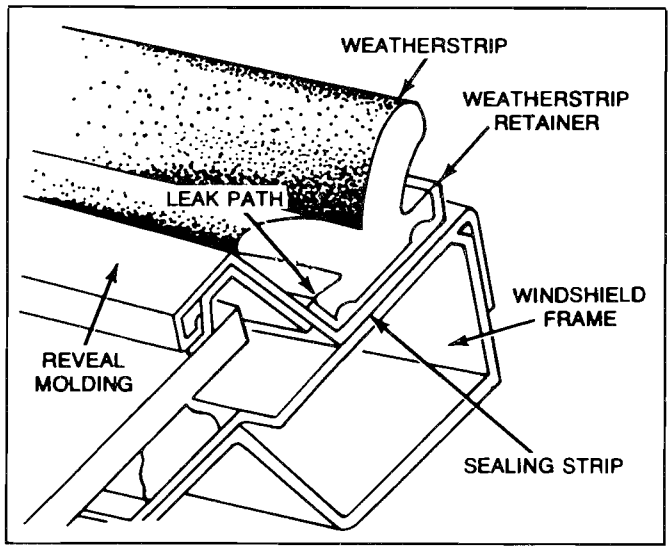


Figure 10B-5 Path 4

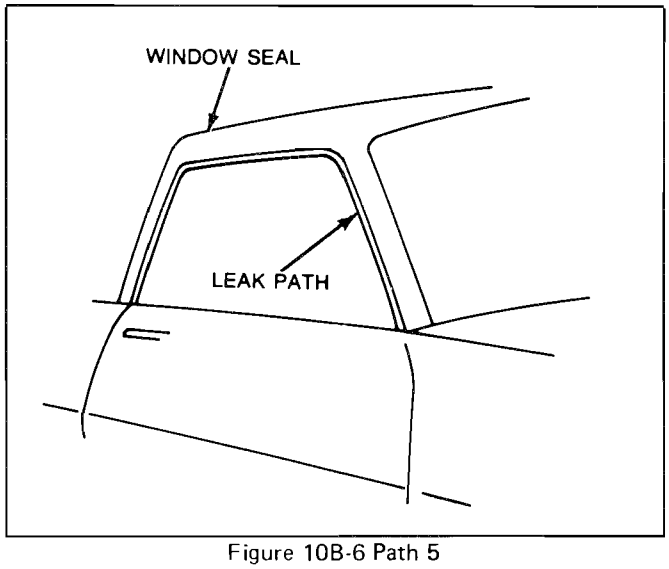


Figure 10B-6 Path 5

assembly. On the roof panel and door glass, the sealing strips are used between the retainer and body or retainer and roof panel..

The weatherstrips seal the roof panel and the door glass from water leaking inside vehicle.

POTENTIAL WATERLEAK PATHS

Figure 10B-2 thru 10B-6 illustrate the typical stackup of parts along the A-pillars. There are 5 paths that could leak:

Path 1: Gaps in the windshield to body primary adhesive or primary adhesive to body due to improper priming or surface preparation.

Path 2: Under the windshield reveal molding. The reveal molding is sealed to the body by the compression of the reveal molding sealing strip.

Path 3: Between the weatherstrip retainer and the reveal molding. This path is also sealed by the compression of the reveal molding sealing strip.

Path 4: Between the weatherstrip and the weatherstrip retainer. In most cases the clinching design of the retainer results in a sealed path, but

weatherstrip adhesive is used toward the outboard side of the retainer to assure a water tight seal.

Path 5: Between the door glass and the door glass weatherstrip.The weatherstrip retainer is positioned during the initial assembly of the vehicle by a fixture which allows for door location and body assembly variations. The door glass is adjusted to the expected sealing position while the fixture is in place.

WATERLEAK PREVENTION

Preparation:

1. Vehicle should be on flat surface.
2. Inspect fits of door glass to weatherstrips to determine if the fit was originally good.
3. Inspect fit of removable roof to body. (Especially joint of side weatherstrips to A-pillar weatherstrips).

Removal of Original Parts

Remove the following:

1. Removable roof panels.
2. Front weatherstrip assembly.
3. Retainers and reveal moldings.

The retainer and reveal molding sealing tape will need to be replaced with new sealing tape.

Inspection

Inspect weatherstrips for tears or breaks in the surface skin. If tears are found, the weatherstrips must be replaced. Any holes in the weatherstrip surface skin can result in water being absorbed, freezing (in cold weather) and rupturing of the weatherstrip. Weatherstrip retainer and reveal molding tape must be replaced with sealing tape.

Installation

1. Install windshield as per standard procedure covered in this section.
2. Replace the windshield reveal molding and retainer sealing tape with new material. The material should not be streched or it may creep after installation causing a gap (leak) in the sealing system.
3. Check the sealing of the windshield by installing the removable roof and taping across the gap between the body and the roof panel. Use a smoke gun or one of the other methods of leak detection covered in this section. This step is suggested because the windshield seal is covered by the reveal moldings.
4. Add thumb grade sealer to each end of retainers and moldings. If thumb grade sealer is soaked in water it is easier to use. The thumb grade sealer should be smoothed out to obtain a continuous sealing surface. Install reveal moldings and original weatherstrip retainers using the original screw holes. Original weatherstrip retainers are used because the retainers are matched to each particular vehicle during production.

Adjustment

1. Install the weatherstrips without using adhesive. Inspect the fit of the weatherstrip to the roof and door glass. It may be necessary to alter the fit of the weatherstrip by using thumb grade sealer to build up the upper corner surface or by moving the weatherstrip corner retainers.
2. Use a smoke gun or one of the other methods of leak detection covered in this section to determine if installation is satisfactory.
3. If the fit is satisfactory remove the weatherstrip and reinstall using weatherstrip adhesive. It is important that the parts of the weatherstrips that are not in the retainer are sealed to the body with a continuous and liberal amount of weatherstrip adhesive. A bead of adhesive should be run inside the weatherstrip retainer toward the outboard side of the retainer. Clean off any adhesive that runs onto the weatherstrip that may touch either the roof weatherstrip or the door weatherstrip. The weatherstrips may stick to each other and cause a tear in the skinned surface when separated.
4. Recheck the entire system for leaks using one of the methods covered in this section.

WATERLEAK DIAGNOSTIC TOOLS AND DIAGNOSIS PROCEDURES

Smoke Gun

(Figure 10B-7)

The smoke gun is used by closing the vehicle windows and doors and using the high-speed blower position on the heater. (A battery charger may be required to prevent the battery from running down). An observer is required outside the vehicle. A mechanic inside the car blows smoke at all the joints and the observer marks where the leaks occur.

Powder Gun

(Figure 10B-8)

The powder gun works like the smoke gun and has the added advantage of leaving "tracks" that pinpoint the leaks.

Sound Detector

(Figure 10B-9)

A sound detector is used by closing all the windows and doors after placing a noise generator inside the car. Leaks are detected by using a sound pickup that can pinpoint even small holes.

Chalking Seals

(Figure 10B-10)

A method to determine the contact area of a weatherstrip is to chalk the weatherstrip and then to close the door. The weatherstrip track will be transferred to the body or adjacent weatherstrip. If the track shows a void, then the weatherstrip must be shimmed or moved.

"Wetting-Out" of Door Glass

(Figure 10B-11)

A method to determine contact of the door glass to the weatherstrips is to wet the surface of the glass and to close the door. The portions of the glass with good contact will "wet-out". Voids will show up as dry areas.

Paper Strip Pressure Test

(Figure 10B-12)

Using a strip of paper about the size of a dollar bill is useful to determine that the weatherstrip is contacted by the door glass. Close the door on the paper and pull the paper. A moderate resistance is good. Very low resistance may indicate a leak.

Pressurizing Passenger Compartment

(Figure 10B-13)

A method to determine if leaks are present is to cover body vents with tape, close all windows, and turn heater blower on high speed. This pressurizes the passenger compartment and allows leaks to be found by spraying a 50/50 mixture of soap and water over all sealing areas. Soap and water mixture will bubble up at leaking areas.

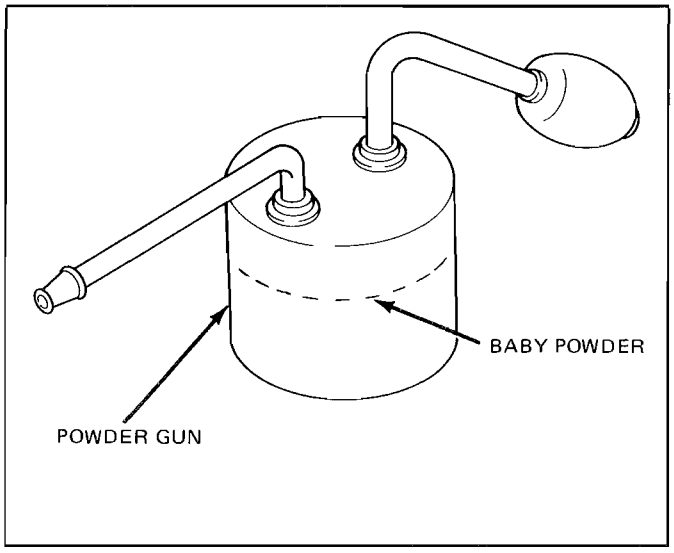


Figure 10B-8 Power Gun

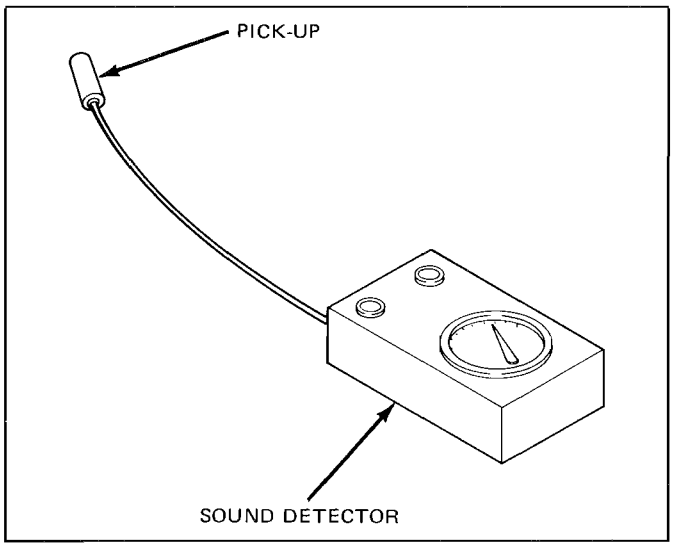


Figure 10B-9 Sound Detector

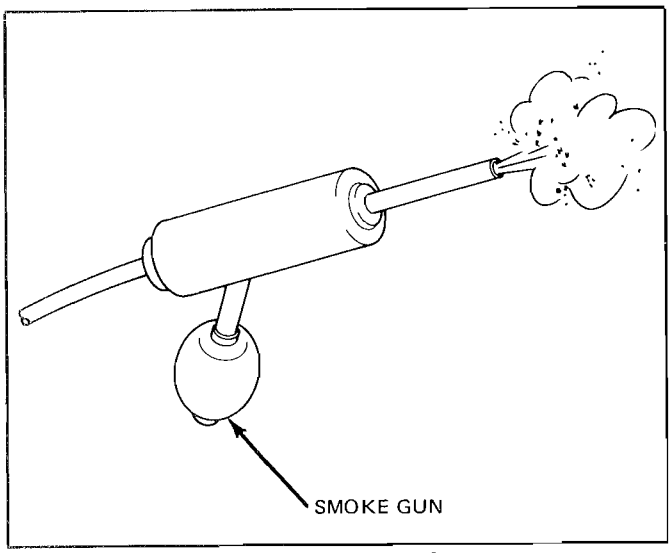


Figure 10B-7 Smoke Gun

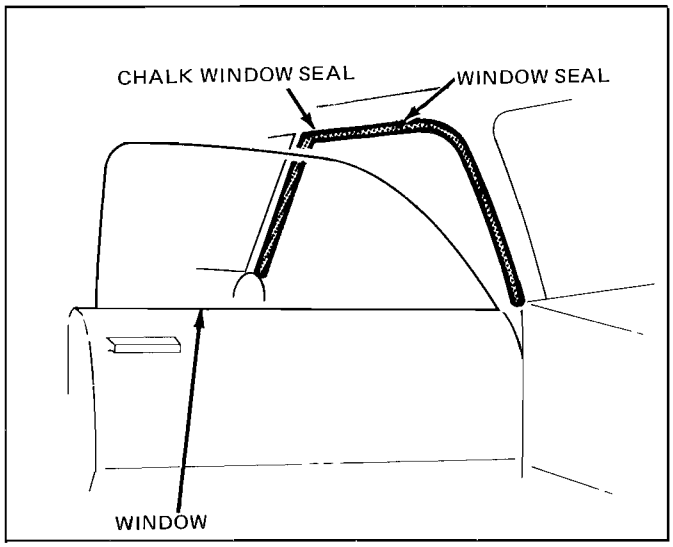


Figure 10B-10 Chalking Seals

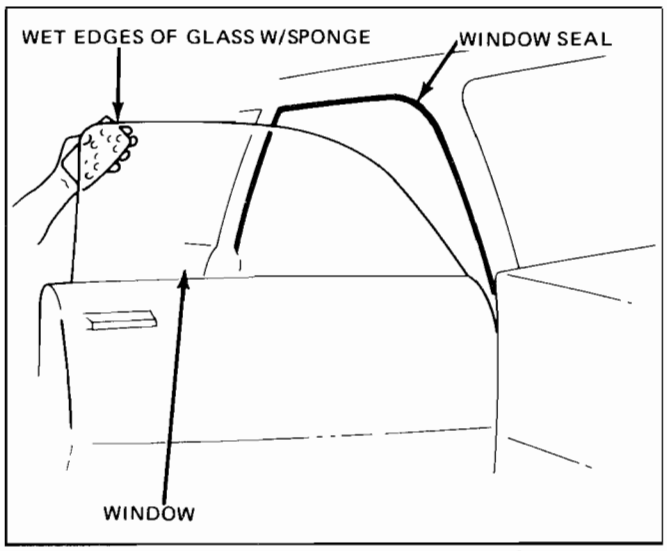


Figure 10B-11 "Wetting-Out" of Door Glass

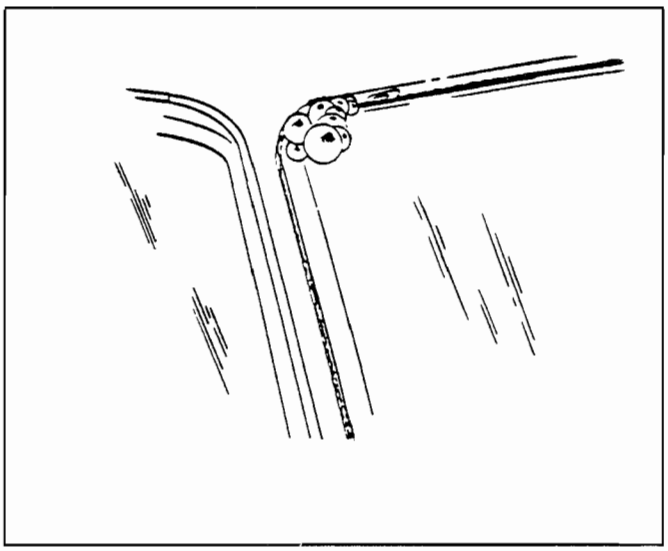


Figure 10B-13 Pressurizing Passenger Compartment

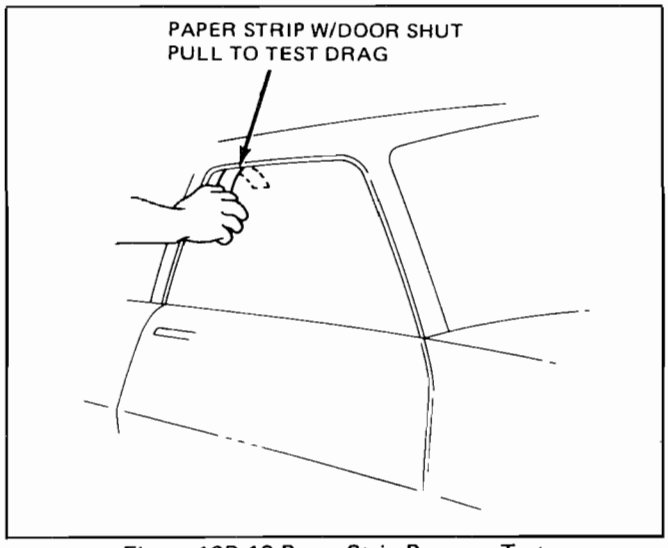


Figure 10B-12 Paper Strip Pressure Test

SECTION 10C

CONVERTIBLE TOP

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GENERAL DESCRIPTION

The new generation convertible features an aerodynamically styled lightweight top, which is manually operated. Top material is smooth, durable cambria cloth or vinyl, while linkage members are cast or extruded aluminum. Joints are teflon-bushed and fastened with shoulder bolts. The system is uncomplicated and balanced for ease of operation. A headliner and vinyl rear window are provided.

The top is stored in a covered well behind the passenger compartment similar to the old design. Three top colors will be available – black (cloth), white (vinyl) and saddle (vinyl).

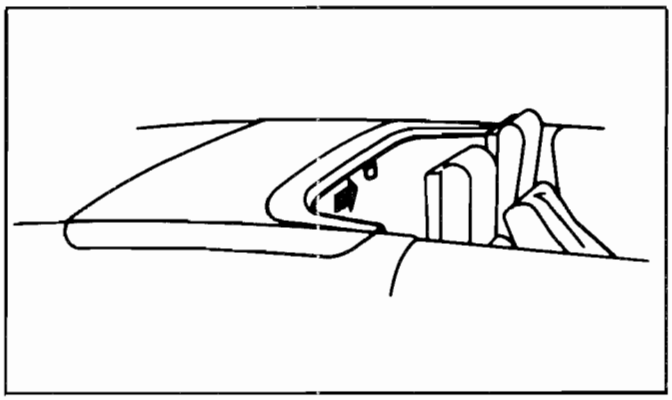


Figure 10C-1 No. 5 Bow Release Lever

OPERATION

TO LOWER TOP

NOTICE: Convertible must be parked on a level surface before lowering or raising top.

1. Set parking brake firmly and shift automatic transmission to "PARK" (Manual Transmission to "Reverse").
2. Lower right and left hand door windows.
3. Turn engine off.
4. Loosen headliner tape fasteners on rear rails at rear of each door window opening.
5. Manually release the convertible top No. 5 bow by reaching under stowage compartment lid and pulling the release lever sideways, see Figure 10C-1.
6. Grasp the center of the convertible top No. 5 bow and lift to vertical position, see Figure 10C-2.
7. Unlock the convertible top stowage lid by pushing the button located at the rear edge of either door, see Figure 10C-3, or button inside of center console.

   The stowage lid may also be released manually by pulling the right and left manual release rings

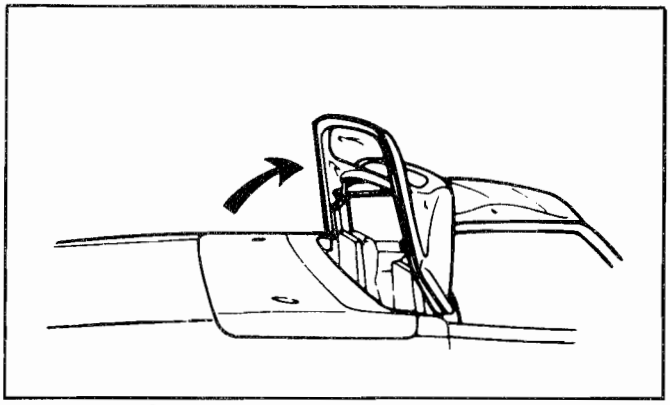


Figure 10C-2 Lifting No. 5 Bow To Vertical Position

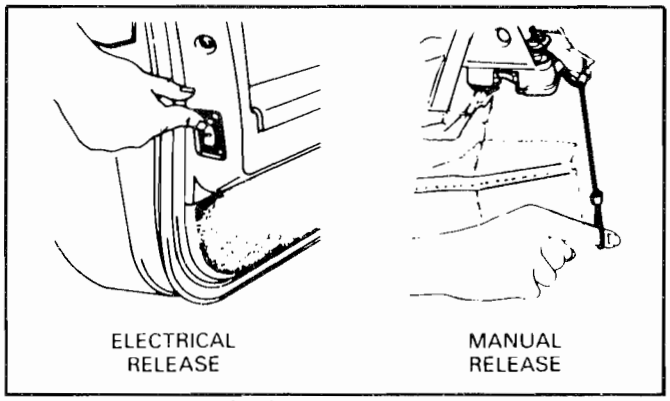


Figure 10C-3 Stowage Lid Release

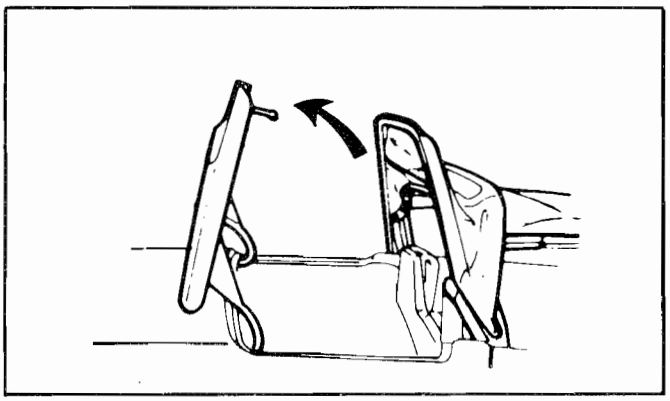


Figure 10C-4 Opening Stowage Lid

located under the forward outer side edges of the stowage lid, see Figure 10C-3.

8. Open convertible top stowage lid to vertical position, see Figure 10C-4.

NOTICE: Before lowering convertible top, make sure there are no objects in the rear stowage compartment area which could interfere with folded stored top. Even small objects could cause damage.

9. Lower rear half of convertible top to original position, see Figure 10C-5.
10. Turn right and left sunvisors downward and unlock front of convertible top by turning right and left levers outboard, see Figure 10C-6. Lift top slightly off windshield header.

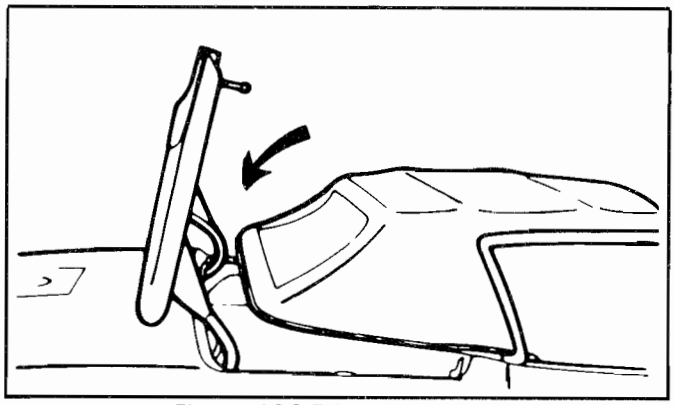


Figure 10C-5 Lowering Top

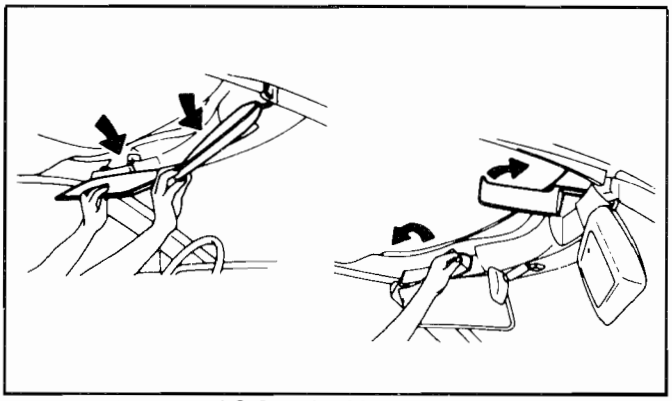


Figure 10C-6 Unlocking Front of Top

11. Grasp front edge of convertible top; lift upward and rearward.
Fold convertible top completely into rear stowage compartment.

NOTICE: Use a slow, smooth motion when lowering convertible top. Avoid jamming convertible top bows against one another which could result in damage or possible breakage of roof bows. Convertible fabric must fold inward between bows.

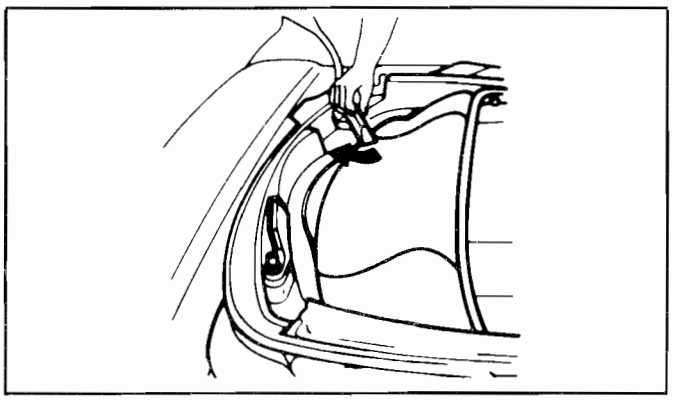


Figure 10C-7 Lever Handles

12. After the convertible top is completely lowered, rotate roof lever handles toward center of vehicle ready for closing of stowage compartment lid, see Figure 10C-7.

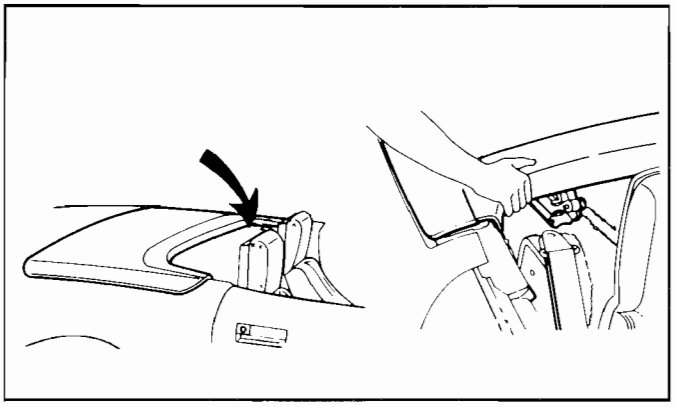


Figure 10C-8 Closing Stowage Lid

13. Close and secure stowage compartment lid by pushing down on front edge of each side of stowage compartment lid until locked.
    Lift gently on both front edges of stowage lid to check for proper latching, see Figure 10C-8.

RAISING THE TOP

1. Before raising the top, firmly set the parking brake and shift the automatic transmission to "PARK" (Manual Transmission in "REVERSE"). Turn engine off.
2. Lower right and left door windows.
3. Turn right and left sunvisors downward and release stowage compartment lid by pushing button at rear edge of either door or button inside of center console.
4. Raise stowage compartment lid.
5. Rotate roof levers in position to latch convertible top to windshield header. Raise convertible top from well and latch to windshield header. Grasp rear edge of convertible top and raise to vertical position. Lower stowage lid and push at center of stowage lid until it is latched securely.
6. Lower rear edge of convertible top and securely latch rear edge to stowage lid.

NOTICE: Do not allow No. 1 Bow to move away or toward windshield header when No.5 Bow is resting, unlatched, on a closed lid. This causes the convertible top to move fore or aft possibly resulting in paint damage from striker pins. See Figure 10C-9.

7. Install tape fasteners on convertible top rear rails to tighten headliner.

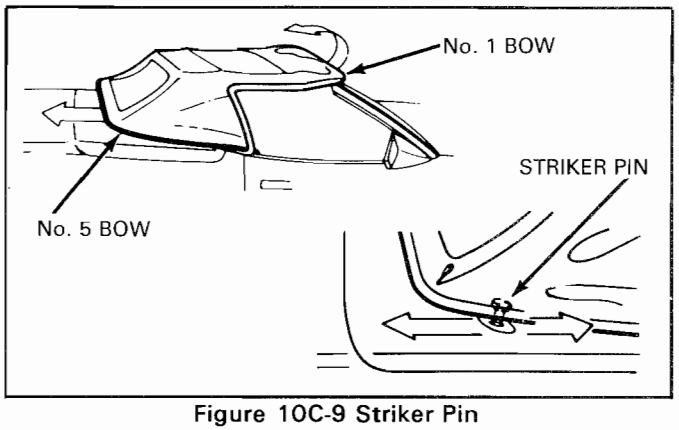


Figure 10C-9 Striker Pin

DIAGNOSIS

Electrical diagnostic information can be found in Section 8A-Electrical Diagnosis.

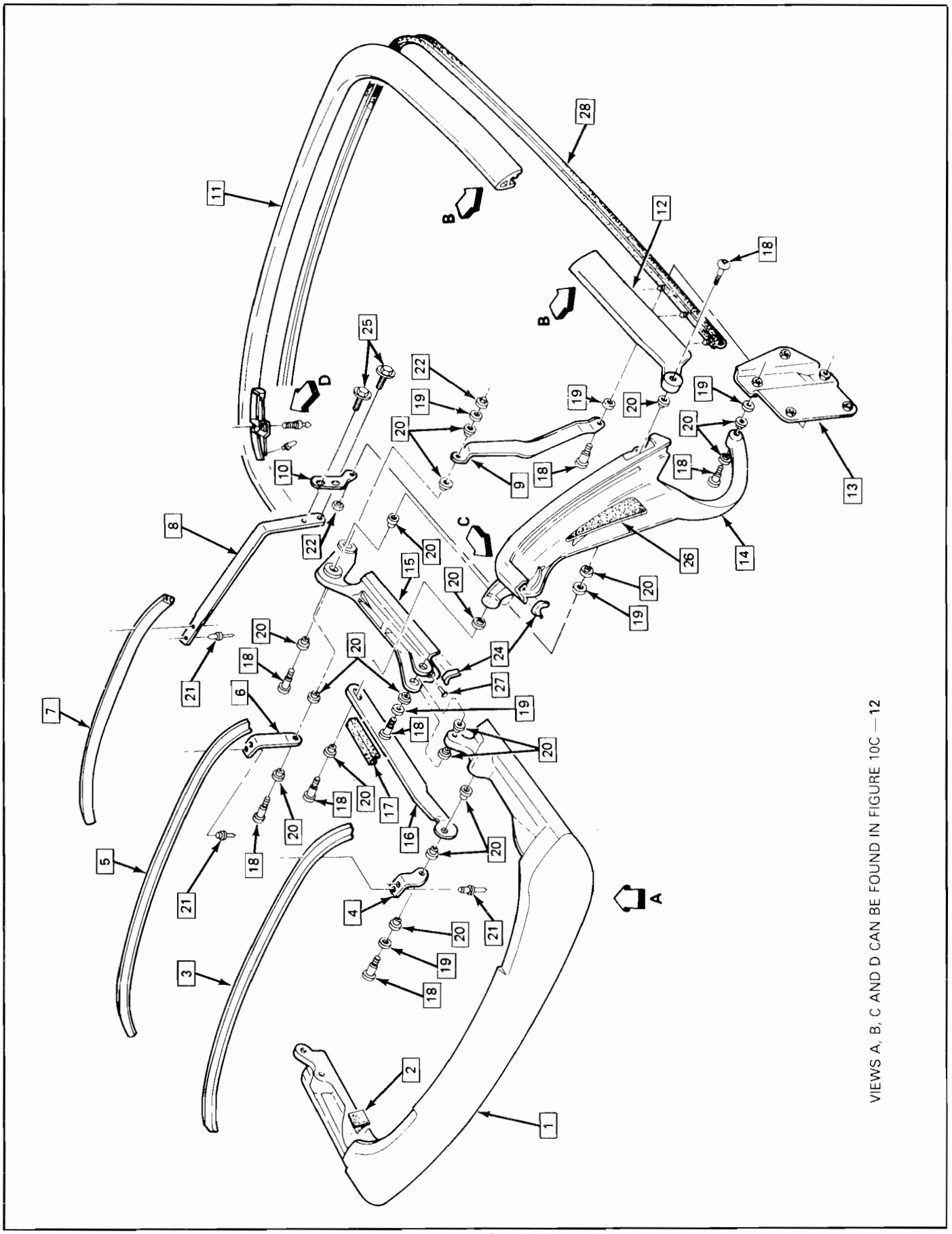
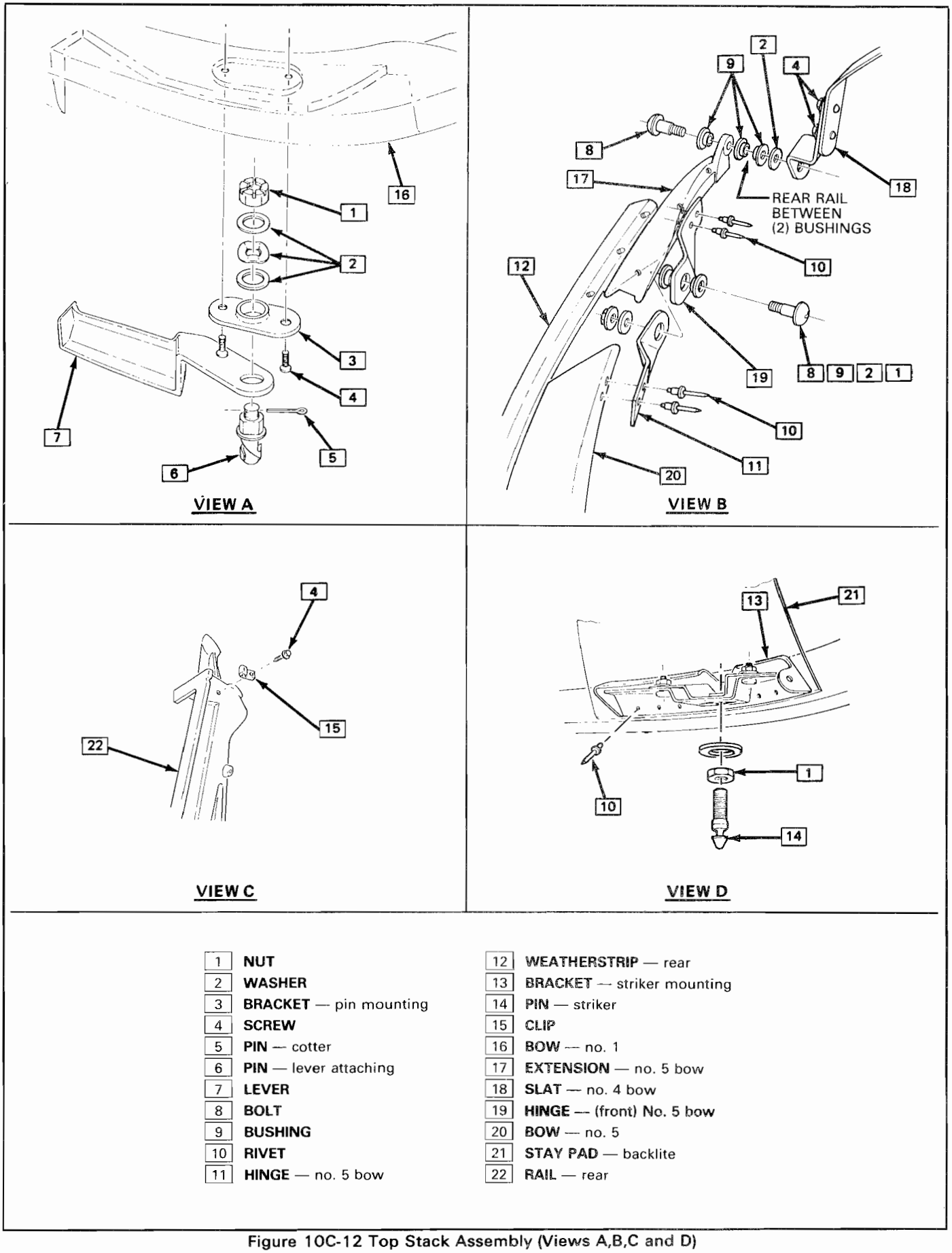


Figure 10C-10 Top Stack Assembly

1. **BOW** — no. 1
2. **TAPE FASTENER**
3. **BOW** — no. 2
4. **BRACKET** — no. 2 bow
5. **BOW** — no. 3
6. **BRACKET** — no. 3 bow
7. **BOW** — no. 4
8. **SLAT** — no. 4 bow
9. **LINK** — balance
10. **BRACKET** — no. 4 bow
11. **BOW** — no. 5
12. **EXTENSION** — no. 5 bow
13. **BRACKET** — main pivot
14. **RAIL** — rear
15. **RAIL** — center
16. **LINK** — control
17. **CHANNEL** — control (rubber)
18. **BOLT*** — 16 N·m (12 ft. lbs.)
19. **WASHER**
20. **BUSHING**
21. **RIVET**
22. **NUT**
23. **SCREW**
24. **SEAL** — rail joint
25. **BOLT**
26. **TAPE FASTENER** — lower rear rail
27. **SCREW** — set
28. **WEATHERSTRIP** — no. 5 bow

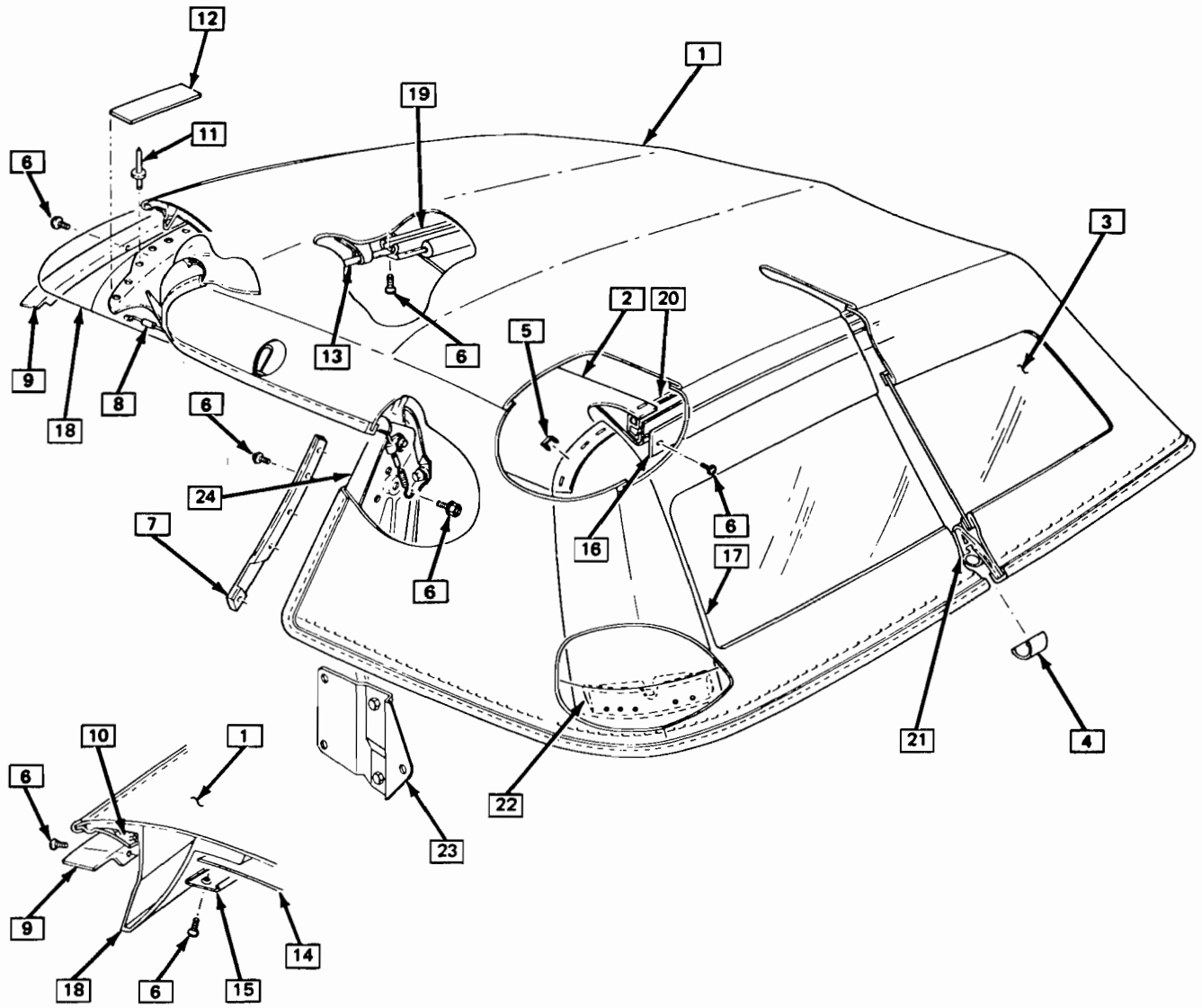
* REQUIRES THREAD LOCKING ADHESIVE BEFORE INSTALLATION

Figure 10C-11 Top Stack Assembly (Legend)



1	**NUT**	12	**WEATHERSTRIP** — rear
2	**WASHER**	13	**BRACKET** — striker mounting
3	**BRACKET** — pin mounting	14	**PIN** — striker
4	**SCREW**	15	**CLIP**
5	**PIN** — cotter	16	**BOW** — no. 1
6	**PIN** — lever attaching	17	**EXTENSION** — no. 5 bow
7	**LEVER**	18	**SLAT** — no. 4 bow
8	**BOLT**	19	**HINGE** — (front) No. 5 bow
9	**BUSHING**	20	**BOW** — no. 5
10	**RIVET**	21	**STAY PAD** — backlite
11	**HINGE** — no. 5 bow	22	**RAIL** — rear

Figure 10C-12 Top Stack Assembly (Views A,B,C and D)



1	**COVER** — top	13	**RETAINER** — top
2	**STAY PAD** — top	14	**HEADLINER**
3	**BACKLITE** — glass	15	**BRACKET** — front
4	**CLIP** — visor	16	**RETAINER** — no. 4 bow
5	**STAPLE**	17	**STAY PAD** — backlite
6	**SCREW**	18	**BOW** — no.1
7	**RETAINER** — rear	19	**BOW** — no. 2
8	**CABLE** — retention	20	**BOW** — no. 4
9	**RETAINER** — front	21	**BOW** — no. 5
10	**ADHESIVE**	22	**BRACKET** — striker mounting
11	**RIVET**	23	**BRACKET** — main pivot
12	**TAPE** — cloth	24	**RAIL** — rear

Figure 10C-13 Top Cover Assembly

ON-CAR SERVICE

HEADLINER

Remove

1. Remove headliner tape fasteners from rear rails and fasteners from No. 5 bow striker mounting brackets.
2. With both sunvisors folded down, remove the headliner front mounting bracket and screws from the No. 1 bow.
3. Remove headliner from No. 2 and No. 3 bows by carefully prying from the bow. NOTE: Plastic retainers are sewn to headliner.
4. Release No. 5 bow from stowage compartment lid and place No. 5 bow in the vertical position.
5. Remove the headliner No. 4 bow retainer and screws.
6. Lower No. 5 bow to stowage compartment lid and latch.
7. Remove headliner from car.

Install

1. Install headliner to No. 2 bow.
2. Install headliner to No. 3 bow.
3. Fasten headliner tape fasteners to No. 1 bow.
4. Install headliner front bracket and screws to No. 1 bow.
5. Release No. 5 bow from stowage compartment lid and place No. 5 bow in vertical position.
6. Install the headliner No. 4 bow retainer and screws.
7. Lower No. 5 bow to stowage compartment lid and latch.
8. Fasten headliner tape fasteners to rear rails.
9. Install fasteners through headliner and attach to No. 5 bow striker mounting brackets.

TOP COVER ASSEMBLY (FIGURE 10C-13)

Remove

1. Remove headliner as previosuly described in this section.
2. Fold top into stowage area.
3. Remove front weatherstrip, retainer and guide. Repeat for opposite side.
4. Remove front retainer from No. 1 bow.
5. Peel front retainer flap from No. 1 bow.
6. Raise top and latch to No. 1 bow.
7. Fold top cover back and disconnect retention cable. Repeat for opposite side.
8. At underside of No. 2 and 3 bow, remove screws securing top retainers and remove retainers, see Figure 10C-14.
9. Remove rear weatherstrips and retainers. Repeat for opposite side.
10. Peel top cover from rear rails.
11. Remove retention cable and clip from rear rail. Repeat for opposite side. NOTE: If cable is in good condition, do not remove from rear rail when replacing top cover.

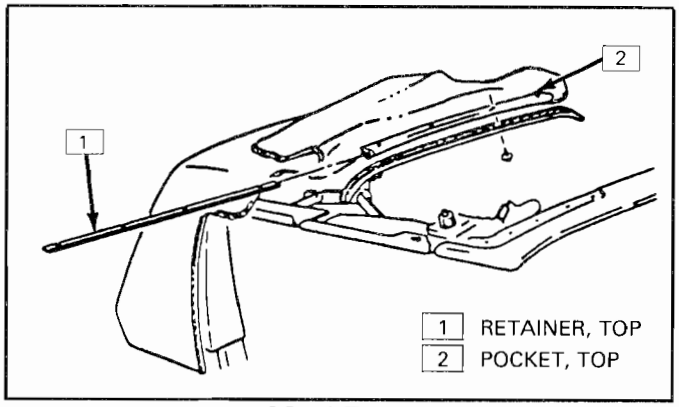


Figure 10C-14 Top Retainers

NOTICE: With No. 5 bow weatherstrip removed, the top surface of the stowage lid must be protected from damage when latching No. 5 bow.

12. Remove No. 5 bow weatherstrip.
13. Peel cover from No. 5 bow.
14. Remove top cover from car.

Install

Before installing top cover assembly, clean all bonding surfaces of adhesive.

1. Position top cover on top stack assembly in a loose fit condition.
2. If cable was removed from rear rail, position retention cable in notch provided in rear rails and install clip and screws. Repeat for opposite side. NOTE: If retention cable was not removed, install into top cover side pockets.
3. Raise top as necessary and hook retention cable to No. 1 bow. Repeat for opposite side.
4. Install top retainers in pockets of top cover and install to No. 2 and No. 3 bows with screws.
5. Pull the front retainer flap over the No. 1 bow.
6. Position the seam along the front edge of the No. 1 bow.
7. Line up split in front retainer flap to centerline of No. 1 bow.
8. Remove any wrinkles that may exist by pulling on the top cover fore or aft as required or side to side as required.

NOTICE: Protect vehicle interior and exterior when applying adhesive.

9. Use a short stiff bristle brush to apply a **VERY THIN** coat of adhesive to one half of the No. 1 bow bonding surface.
10. Check that front retainer flap split is on center and seam is in position with edge of No. 1 bow.
11. Starting in the center and working outboard with minimal stretch, attach the retainer flap to No. 1 bow.
12. Repeat Steps 9, 10 and 11 for opposite half of No. 1 bow.
13. Install front retainer and screws to No. 1 bow.

14. Latch No. 1 bow to windshield header and No. 5 bow to stowage lid.
15. Apply a **VERY THIN** coat of adhesive to rear rail.
16. Pull the sail panel retainer flap over the rear rail.
17. Smooth wrinkles from sail panel and attach retainer flap to rear rail.
18. Install rear retainer and screws.
19. Repeat Steps 15 thru 18 for opposite side.
20. Release No. 5 bow from stowage lid.
21. Pull the rear retainer flap over the No. 5 bow.
22. Line up top cover visor clip with notch in center edge of No. 5 bow.
23. Apply a **VERY THIN** coat of adhesive to one half of the No. 5 bow bonding surface.
24. Check that top cover visor clip is on center with notch in No. 5 bow.
25. Starting in the center and working outboard with minimal stretch, attach rear retainer flap to No. 5 bow.
26. Repeat Steps 23, 24 and 25 for opposite half of No. 5 bow.
27. Install No. 5 bow weatherstrip, see No. 5 Bow Weatherstrip Removal and Installation.
28. Latch No. 5 bow to stowage lid and check weatherstrip seal. Adjust striker pins as necessary.
29. Install rear retainer and screws.
30. Fold top back to expose top of rear retainer for weatherstrip installation.
31. Start weatherstrip at top by feeding into retainer and working all the way down.
32. Install fastener on underside of weatherstrip.
33. Repeat Steps 29 thru 32 for opposite side.
34. Install front retainer and guide.
35. Adjust guide fore and aft as necessary.
36. Install weatherstrip into front retainer.
37. Install fastener.
38. Latch front of top to windshield.
39. Roll windows up and check weatherstrip seal. Adjust as necessary. Refer to Section 10B for additional information on how to determine water or air leaks.
40. Repeat Steps 34 thru 39 for opposite side.

STAY PADS

Remove

1. Remove headliner and top cover assembly as previously described in this section.
2. Latch No. 1 bow to windshield header and No. 5 bow to stowage lid.

NOTICE: The following dimensions are critical to installation of the stay pads and must be taken accurately for best results.

3. Before removing stay pads, measure and record the following dimensions for installation, see Figure 10C-15.
   - Front edge of No. 1 bow to centerline of No. 2 bow.
   - Front edge of No. 1 bow to centerline of No. 3 bow.
   - Front edge of No. 1 bow to centerline of No. 4 bow.
4. Mark relationship of inboard edges of stay pads to No. 4 bow. Repeat for opposite side.
5. Remove staples from No. 4 bow. Repeat for opposite side.
6. Release No. 5 bow from stowage lid and raise to vertical position.
7. Drill out rivets from No. 5 bow striker mounting bracket to remove stay pad. Repeat for opposite side.
8. Latch No. 5 bow to stowage lid.
9. Remove staples from No. 3 and No. 2 bow. Repeat for opposite side.
10. Remove tape, drill out rivets and remove stay pad from No. 1 bow. Repeat for opposite side.

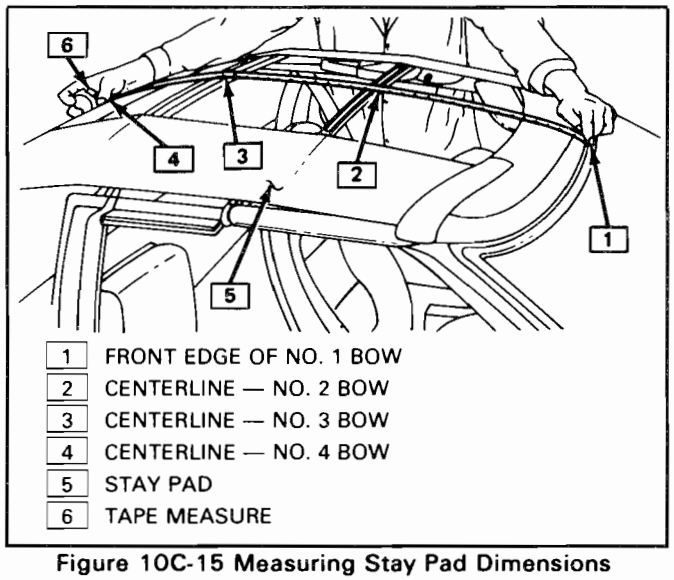


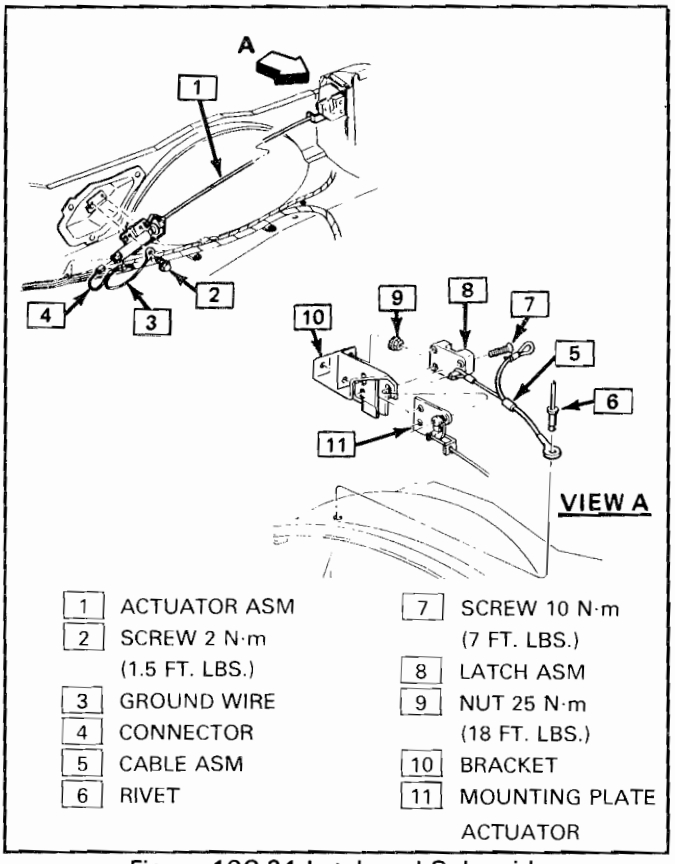
Figure 10C-15 Measuring Stay Pad Dimensions

Install

1. Install stay pad to No. 1 bow with .125" rivets. Repeat for opposite side. Note: If any rivets are protruding from stay pad, flatten with a nylon hammer as required.
2. Cover rivets with 2 inch wide cloth tape. Repeat for opposite side.
3. Line up stay pad to mark on No. 4 bow made during removal.

NOTICE: Dimensions recorded during removal are critical to stay pad installation and must be maintained during stapling. No. 1 and No. 5 bow must be latched before proceeding.

4. Measure and position No. 2 bow to dimension taken during removal.
5. Stretch stay pad over No. 2 bow, check dimension, and staple as follows:
   - Starting at the inboard side of the stay pad and working outboard, secure the stay pad to the No. 2 bow using 8 staples not more than .750" apart.



1 ACTUATOR ASM
2 SCREW 2 N·m (1.5 FT. LBS.)
3 GROUND WIRE
4 CONNECTOR
5 CABLE ASM
6 RIVET
7 SCREW 10 N·m (7 FT. LBS.)
8 LATCH ASM
9 NUT 25 N·m (18 FT. LBS.)
10 BRACKET
11 MOUNTING PLATE ACTUATOR

Figure 10C-21 Latch and Solenoid

3. Pull back carpeting.
4. Remove 2 screws holding solenoid.
5. Disconnect solenoid connection.
6. Remove latch, see Latch Removal.
7. Remove solenoid assembly.

Install

1. Install solenoid with ground wire under one of the 2 screws.
2. Reconnect solenoid connection.
3. Install latch plate actuator to latch, see Latch Install.
4. Check operation of solenoid.
5. Reinstall carpeting.
6. Close stowage lid.
7. Secure top.

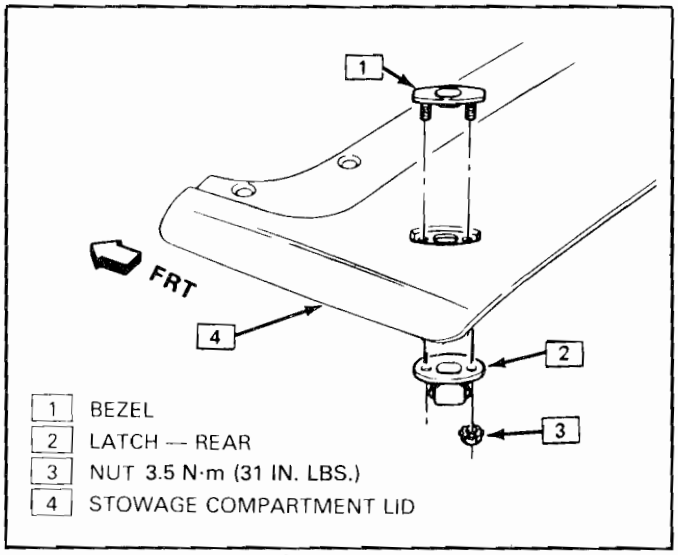
Latch Assembly Rear (Figure 10C-22)

Remove

1. Raise No. 5 bow to vertical position.
2. Open stowage lid.
3. Remove the 2 nuts.
4. Remove screw securing end of release cable to stowage lid.
5. Remove latch.
6. Disconnect latch from release cable.

Install

Reverse removal procedure and torque nuts.



1 BEZEL
2 LATCH — REAR
3 NUT 3.5 N·m (31 IN. LBS.)
4 STOWAGE COMPARTMENT LID

Figure 10C-22 Latch Assembly Rear

WEATHERSTRIPS AND SEALS

Front/Intermediate Weatherstrips and Retainers (Figure 10C-23)

Remove

1. Remove weatherstrips from retainers.
2. Remove plastic fastener from intermediate weatherstrip for reuse during installation.
3. Remove retainers.
4. Remove guide.
5. Clean mounting surface.

Install

1. Apply sealer across top and down both sides of guide mounting surface and place in position on No. 1 bow.
2. Position guide as far forward in the mounting slots as possible.
3. Remove protective backing from front retainer and position over guide and holes in roof frame.
4. Install screws.
5. Remove protective backing from intermediate retainer and position over holes.
6. Install screws.
7. Apply a dab of adhesive to the front corner of the roof frame.
8. Insert fastener into intermediate weatherstrip prior to installation and install weatherstrips into retainers.
9. Roll window up and check weatherstrip seal to window. Adjust as necessary.

Rear Weatherstrip and Retainer (Figure 10C-23)

Remove

1. Remove fastener from underside of rear rail.
2. Remove rear weatherstrip from retainer.
3. Remove screws and rear retainer.
4. Clean mounting surface.

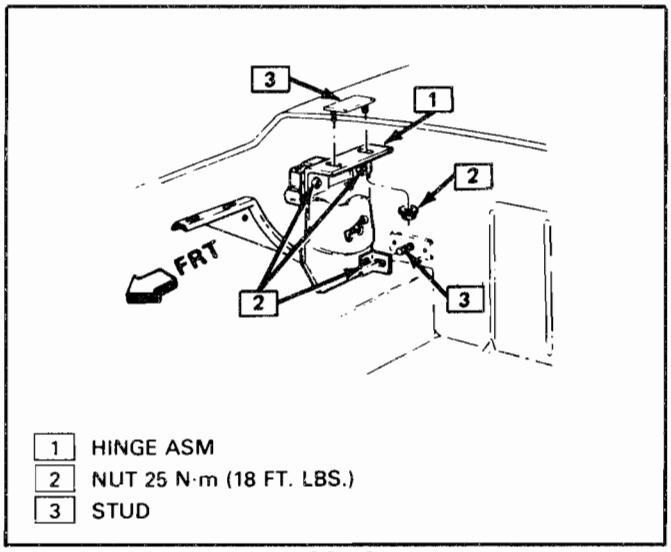


Figure 10C-18 Hinge

NOTICE: Protect vehicle surface when removing stowage lid to hinge bolts. Lid will contact body with bolts removed.

3. Remove hinge.

Install

1. Install hinge.
2. Close lid and check fit to body, adjust as necessary.
3. Torque bolts.
4. Close lid and recheck fit.
5. Latch No. 5 bow to stowage lid.

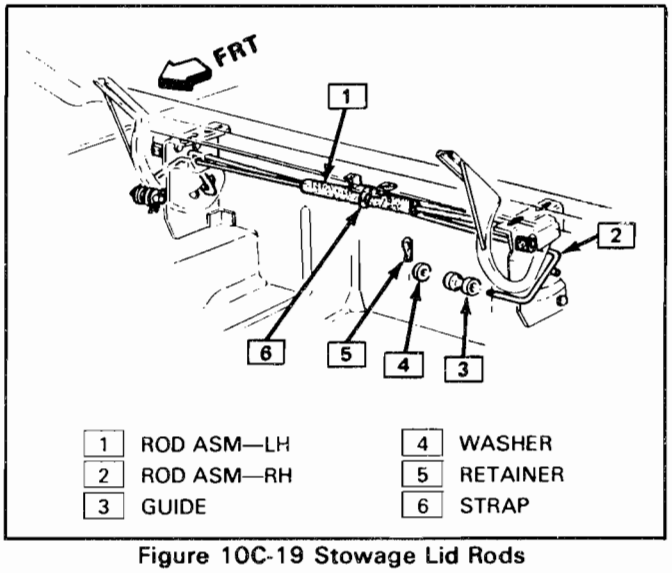


Figure 10C-19 Stowage Lid Rods

Stowage Lid Rods (Figure 10C-19)

Remove

1. Remove strap.
2. Remove rod(s).

Install

1. Install rod(s) to hinge support, engaging end of rod(s) in second notch of hinge support.
2. Install strap.

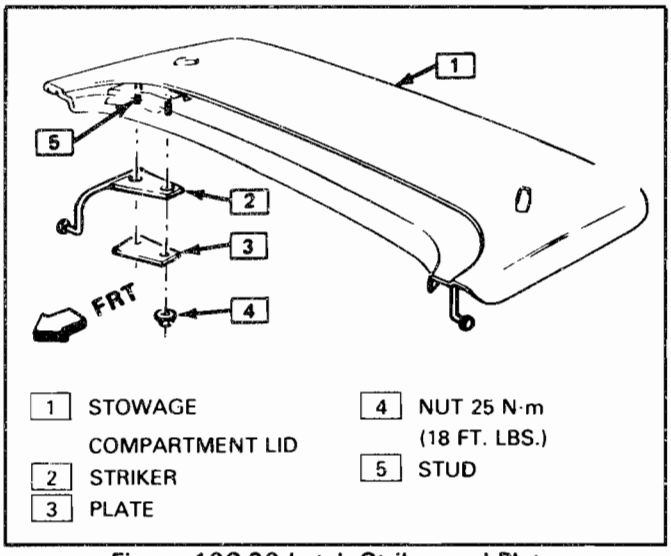


Figure 10C-20 Latch Striker and Plate

Latch Striker and Plate (Figure 10C-20)

Remove

1. Raise No. 5 bow to vertical position.
2. Open stowage lid.
3. Remove 2 nuts holding striker.
4. Remove striker and plate.

Install

Reverse removal procedures, adjust striker and torque nuts.

Latch Assembly (Figure 10C-21)

Remove

1. Raise No. 5 bow to vertical position.
2. Open stowage lid.
3. Pull back carpeting to access latch.
4. Remove 3 screws attaching latch assembly to bracket.
5. Remove latch assembly.

Install

1. Place manual release wire over latch assembly pin.
2. Install latch assembly and 3 screws.
3. Snug up screws.
4. Close lid and check for proper fit of stowage lid to body.
5. Adjust latch up or down if necessary and recheck fit.
6. Torque screws.
7. Reinstall carpeting.
8. Close stowage lid.
9. Secure folding top.

Solenoid Asm (Figure 10C-21)

Remove

1. Raise No. 5 bow to vertical position.
2. Open stowage lid.

Install

1. Apply weatherstrip adhesive to No. 5 bow channel.
2. Guide weatherstrip into channel in No. 5 bow.
3. Install fasteners located on the end of the weatherstrip into the No. 5 bow.
4. Latch No. 5 bow to stowage lid, check seal and adjust striker pins as necessary.

Stowage Compartment Lid Weatherstrip (Figure 10C-23)

Remove

1. Open stowage compartment lid.
2. Remove weatherstrip by prying fasteners from stowage lid.

Install

Reverse removal procedure, check seal to body. Adjust as necessary.

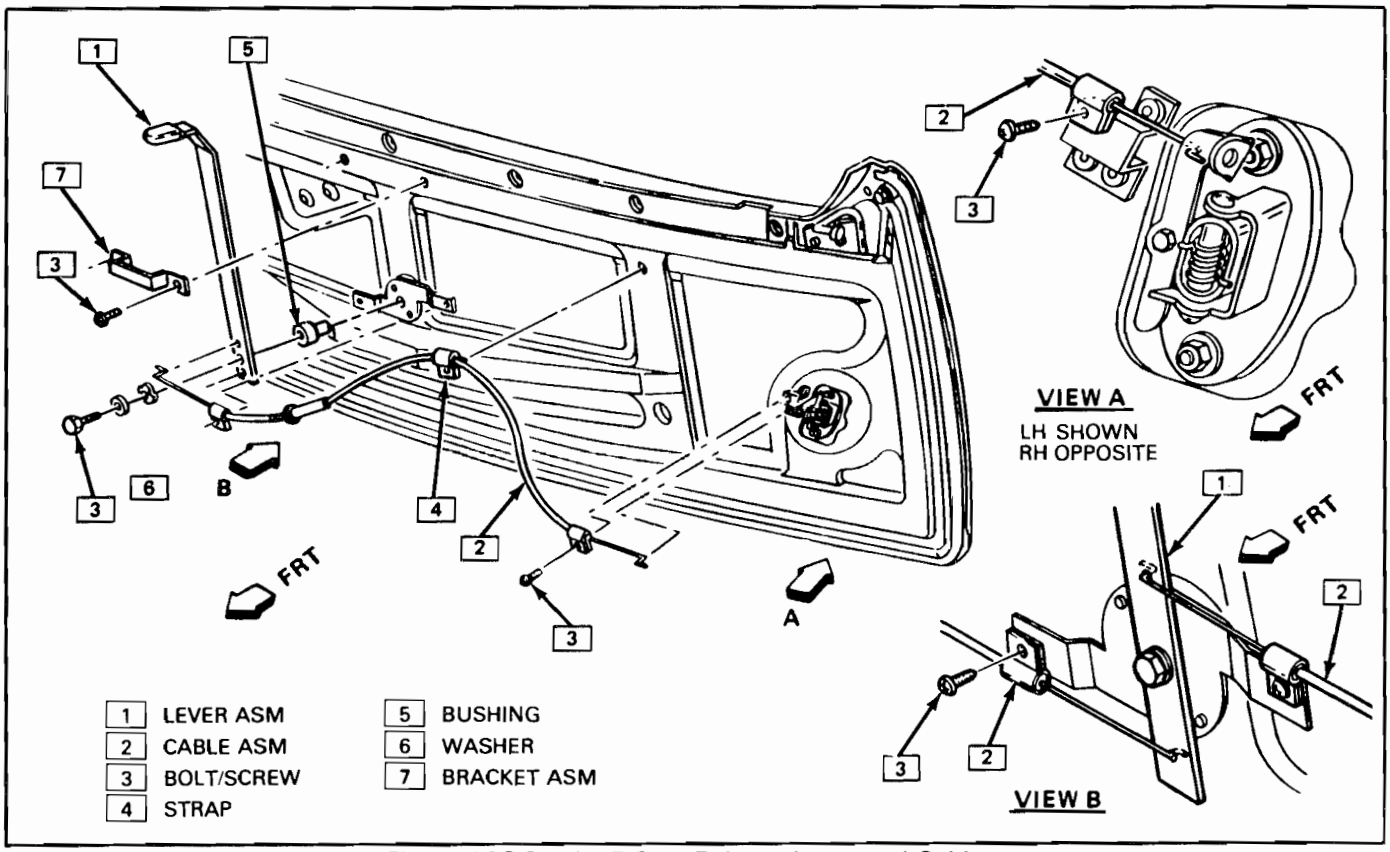


Figure 10C-24 No. 5 Bow Release Lever and Cables

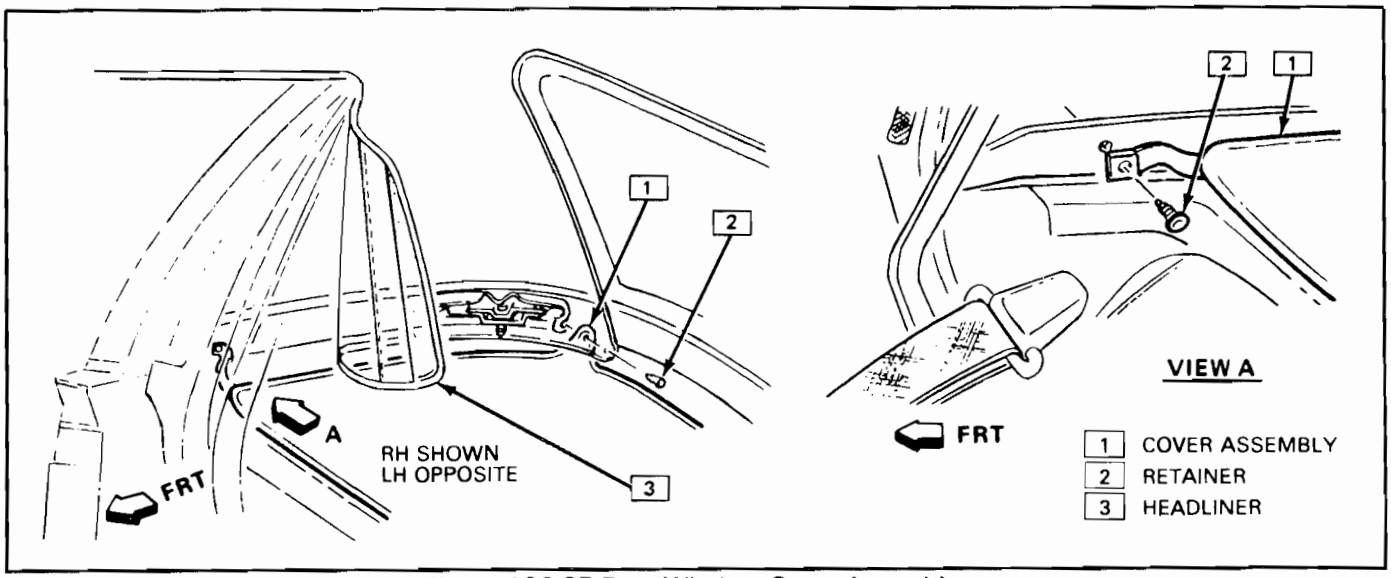
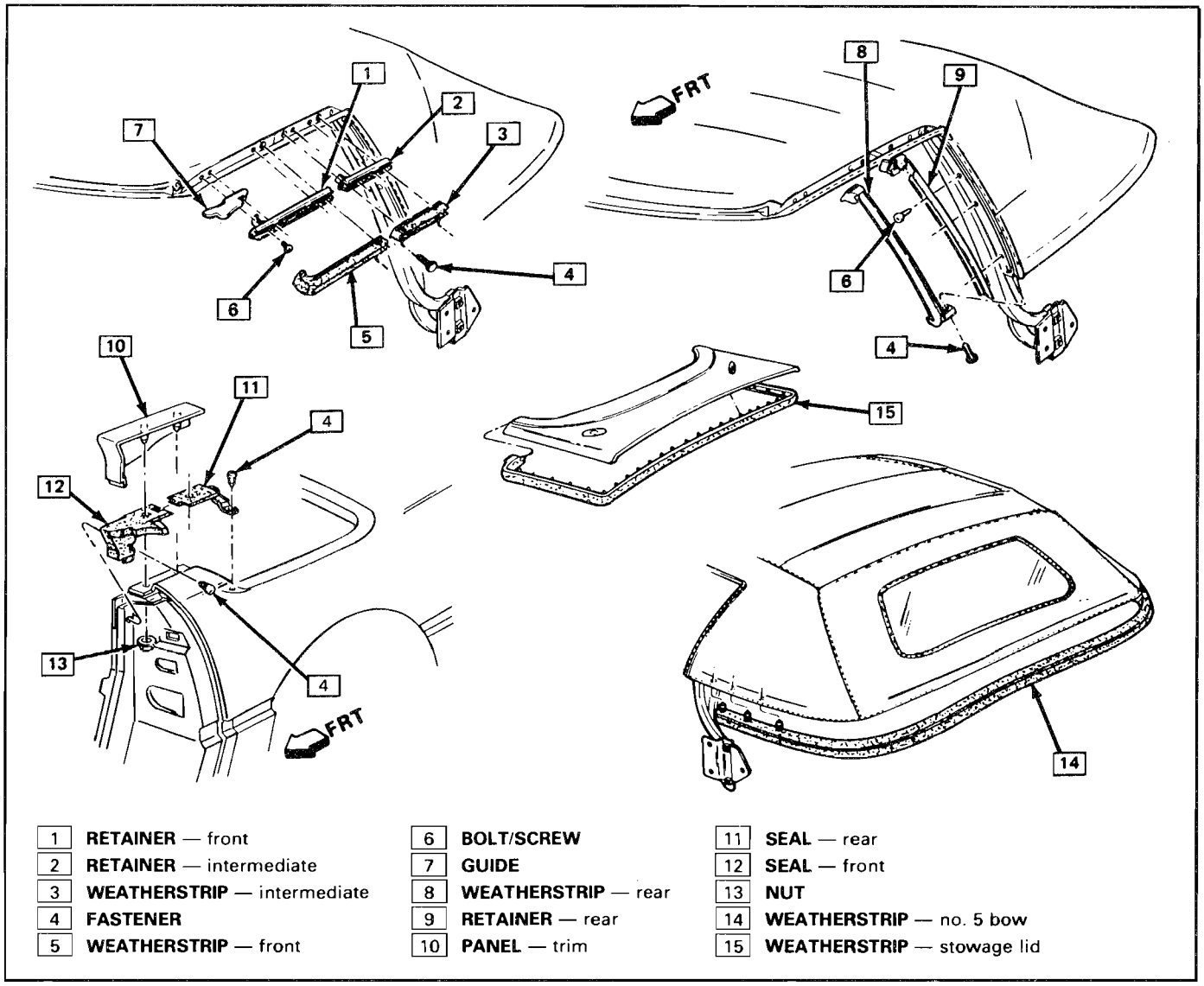


Figure 10C-25 Rear Window Cover Assembly



1	RETAINER — front	6	BOLT/SCREW	11	SEAL — rear
2	RETAINER — intermediate	7	GUIDE	12	SEAL — front
3	WEATHERSTRIP — intermediate	8	WEATHERSTRIP — rear	13	NUT
4	FASTENER	9	RETAINER — rear	14	WEATHERSTRIP — no. 5 bow
5	WEATHERSTRIP — front	10	PANEL — trim	15	WEATHERSTRIP — stowage lid

Figure 10C-23 Weatherstrips and Seals

Install

1. Remove protective backing from rear retainer and position over holes in rear rail.
2. Install screws.
3. Apply adhesive to the entire length of rear retainer and to underside of rear rail.
4. Insert rear weatherstrip into retainer and position bottom of weatherstrip to underside of rear rail.
5. Retain bottom of weatherstrip to rear rail with fastener.
6. Roll window up and check weatherstrip seal to window. Adjust as necessary.

Front and Rear Seals (Figure 10C-23)

Remove

1. Remove trim panel nuts and trim panel.
2. Remove front and rear seals.
3. Remove plastic fasteners from seals for reuse during installation.
4. Clean mounting surface.

Install

1. Apply a bead of sealer to the entire length of the body panel flange.
2. Position front seal over hole in body panel and to contour of door sealing panel. Install fastener.
3. Position rear seal over hole in body panel. Install fastener.
4. Position trim panel over seals and retain to pillar cap with nuts.

No. 5 Bow Weatherstrip (Figure 10C-23)

Remove

1. Raise No. 5 bow to vertical position.
2. Remove weatherstrip by prying fasteners, located on ends of weatherstrip, from No. 5 bow.
3. Complete removal by pulling weatherstrip from channel in No. 5 bow.

NOTICE: With No. 5 bow weatherstrip removed, the top surface of the stowage lid must be protected from damage when latching No. 5 bow to stowage lid.

DEFINITIONS OF ABBREVIATIONS

AFT — Rearward

BCM — Body Computer Module

(C3I) or CCCI — Computer Controlled Coil Injection

CPS — Central Power Supply

CRT — Cathode Ray Tube

DAB — Delayed Accessory Buss

EBS — Electronic Brake System

ECC — Electronic Climate Control

ECM — Electronic Control Module

EGR — Exhaust Gas Recirculation

EMR — Electronic Module Retard

ESC — Electronic Spark Control

EST — Electronic Spark Timing

ESS — Electronic Spark Selection

EVRV — Electronic Vacuum Regulator Valve

FDC — Fuel Data Center

HEI — High Energy Ignition

ISC — Idle Speed Control

LED — Light Emitting Diode

PTC — Positive Temperature Coefficient (Resistor)

PWM — Pulse Width Modulated

SFI — Sequential Fuel Injection

TCC — Torque Converter Clutch

TCS — Temperature Control Switch

TMNSS — Transmission Mounted Neutral Safety Switch

UART — Universal Asynchronous Receiver Transmitter

VF — Vacuum Fluorescence

° Low-Energy Circuit

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS

Circuit Number	Circuit Color	Circuit Name
2	Red	Battery, Unfused Feed
3	Pink	Ignition Switch "On and Crank" Controlled, Unfused Feed
4	Brown	Ignition Switch "Accessory and On" Controlled Unfused Feed
5	Yellow	Neutral Safety Start Switch or Starter Relay Feed
6	Purple	Starter Solenoid Feed
7	Yellow	Primary Ignition Resistance Bypass
8	Gray	Instrument Panel Lamps (Fused Number 44 Circuit)
9	Brown	Tail, License, Park and Side Marker Lamp Feed
10	Yellow	Dimmer Switch Feed
11	Light Green	Headlamp High-Beam Feed
12	Tan	Headlamp Low-Beam Feed
13	Purple	Front Parking Lamps
14	Light Blue	Left Hand Indicator and Front Directional Lamps
15	Dark Blue	Right Hand Indicator and Front Directional Lamps
16	Purple	Directional Signal Switch, Feed From Flasher
17	White	Directional Signal Switch, Feed From Stop Switch
18	Yellow	Stop and Directional Lamp or Directional Lamp Only – Rear Left Hand
19	Dark Green	Stop and Directional Lamp or Directional Lamp Only – Rear Right Hand
20	Light Blue	Stop Lamp (Only)
21	Pink	Spot Light
22	White	Trailer – Direct Ground
23	Gray	Alternator "F+" Terminal (Regulator Monitor)
24	Light Green	Back Up Lamp Feed
25	Brown	Voltage Regulator Controlled Reference Voltage "F–"
26	Dark Blue	Field Circuit (Generator, Regulator)
27	Brown	Traffic Hazard Switch, Feed From Hazard Flasher
28	Black	Horn Switch Controlled Ground
29	Dark Green	Horn Feed
30	Pink	Fuel Gauge to Tank Unit
31	Tan	Oil Pressure
32	Yellow	Map Light Feed
33	Tan/White	Warning Light – Brake
34	Purple	Fog or Drive Lamp
35	Dark Green	Engine Coolant Temperature (Hot) Switched Ground or ECM Controlled Ground
36	Light Green	Engine Temperature (Cold) Switch Controlled Ground
37	Light Green	Engine Metal Temperature (Hot) Switch Controlled Ground
38	Dark Blue	Flasher Fused Feed *
38	Pink/Black	Ignition Switch "On and Crank" Controlled, Fused Feed Battery, Fused Feed
41	Brown/White	Ignition Switch "Accessory and On" Controlled, Fused Feed
42	Yellow	Air Conditioning, Automatic Relay Controlled, Feed
43	Yellow	Radio Feed
44	Dark Green	Instrument Panel Lamps (Usually Light Switch to Fuse) Feed
45	Black	Marker and Clearance Lamps (Trailers)
46	Dark Blue	Rear Seat Speaker Feed From Single Radio or Right Stereo
47	Dark Blue	Auxiliary Circuit (Trailer)
48	Gray	Tail Lamp, Headlamp Switch "On" or Directional Signal and Stop, Headlamp Switch "Off", Rear Left Hand
49	Dark Blue	Tail Lamp, Headlamp Switch "On" or Directional Signal and Stop, Headlamp Switch "Off", Rear Right Hand
50	Brown	Ignition Switch "On" Controlled, Fused Feed
51	Yellow	Blower Resistor Feed, Low
52	Orange	Blower Switch "High" or Selector Switch "Maximum Cold" Controlled Feed
53	Light Green	Valve Release Solenoid to Control Box
54	Dark Green	Control to Shield
55	Orange	Kick Down Solenoid Feed
56	Tan	Amplifier to Transducer
57	Orange	Left Hand Cornering Lamp Feed
58	Black	Right Hand Cornering Lamp Feed
59	Dark Green	Compressor Feed
60	Orange/Black	Battery, Circuit Breaker Protected Feed
61	Yellow	Automatic Air Conditioning, Ambient Sensor Controlled, Resistive Ground
62	Light Green	Automatic Air Conditioning, Feedback Pot Controlled, Resistive Ground
63	Tan	Blower Switch "Medium 1" Controlled Feed
64	Brown	Air Conditioning Selector Switch to Blower Switch, Feed
65	Purple	Blower Motor Feed
66	Light Green	Air Conditioning Selector Switch Controlled (Compressor Circuit) Feed
67	Light Blue	AC Freon Pressure, Cooling Fan Reversing Relay Control or AC Freon Pressure, Cutout SW Controlled Feed
68	Yellow/Black	Resistive, Low Coolant Probe Controlled, Ground
69	Gray	Low Coolant Module Controlled Ground
70	Pink	Relay Controlled, Ignition Switch Controlled Feed
71	Light Blue/ Black	Air Conditioning Selector Switch, "Defroster" Controlled Ground
72	Light Blue	Blower Switch "Medium 2" Controlled Feed
73	Purple/White	Blower Switch "Medium 3" Controlled Feed
74	Light Green	Throttle Switch Feed
75	Dark Blue	Ignition Switch "On and Crank" Controlled, Fused Feed

* Low-Energy Circuit

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS (Cont'd)

Circuit Number	Circuit Color	Circuit Name
76	Pink	Ignition Switch "On" Controlled, Feed
77	Light Green/ White	A/C Selector Switch Controlled Switched Ground
78	Light Blue	Electric Choke Feed
79	Pink	Fuel Filler Door Release – Switched Feed
80	Light Green	Key Warning Buzzer, Ground
81	White	Electric Remote Mirror Motion "Right" (May be Driver's Door Only")
82	Light Blue	Electric Remote Mirror, Motion Left
83	Dark Green	Cruise Engage Switch "Retard" Controlled, Feed
84	Dark Blue	Cruise Engage Switch, "Engage" Controlled, Feed
85	White	Cruise Indicator, Regulator Controlled Ground
86	Brown	Cruise Brake Release Switch Controlled Feed
87	Gray/Black	Resume Solenoid, Brake Switch Controlled Feed
88	Yellow	Electric Remote Mirror, Motion Up
89	Light Green	Electric Remote Mirror, Motion "Down", (May be Driver's Door Only)
90	Pink	Cutout Switch Controlled, Circuit Breaker Protected, Feed
91	Gray	Windshield Wiper, Low
92	Purple	Windshield Wiper, High
93	White	Windshield Wiper Motor Feed
94	Pink	Windshield Washer Switch to Washer
95	Dark Green	Pulse Wiper Switch Controlled Ground
96	Brown	Pulse Wiper Rheostat Switch Controlled, Feed
97	Light Blue	Windshield Wiper, Pulse/Low
98	Orange	Dynamic Break, "B Plus" Switch Wiper Motor, Feed
99	Black/White	Windshield Washer Low Fluid — Telltale
100	Brown	Brake Vacuum Pump Feed, Switch Controlled
101	Dark Blue	Resistor Output to Blower Relay
102	White	Alternator – Regulator Sensing Circuit
103	White	Actuator Motor Isolation Relay Feed; Headlamp Switch Controlled
104	Dark Blue/ White	Headlamp Isolation Relay to Right Door Actuator Motor
105	Black	Ammeter – Generator
106	Gray	Ammeter – Battery
107	Dark Blue	Over Speed Warning Light
110	Dark Blue	Headlamp Isolation Relay to Left Door Actuator Motor
111	Black	Anti-Skid Low Air Switch Controlled Ground
112	Dark Green	Telltale Temperature (Hot) Gauge
113	Pink	Headlamp Door Isolation Relay to Door Actuator Relay Coil
115	Light Blue	Right Rear Stereo Speak Return
116	Yellow	Left Rear Stereo Speaker Return
117	Dark Green	Right Front Stereo Speaker Return
118	Gray	Left Front Stereo Speaker Return
119	White	Generator (Alternator) to Regulator
120	Tan/White	Electric Fuel Pump Fused Feed (Tan Only for F.B.)
121	White	Tachometer to Coil
122	Red	Rear Fog Lamp – Feed
123	Tan	Overnight Parking – Feed
124	Light Blue	Back-Up Relay, Feed to Coil
125	Yellow	Door Jamb Switch
126	Black	Seat Back Lock
127	Dark Green	"Open" Sunroof From Motor
128	Dark Blue	Sunroof Controlled Ground
129	Light Green	"Close" Sunroof From Motor
130	Brown/White	Generator (Alternator) External Resistance, 2 Ohms/Foot
131	Black/Pink	Generator (Alternator) External Resistance, 1 Ohm/Foot
132	White	Fuel Economy Switch Controlled, Amber Telltale, Ground
133	Yellow	Fuel Economy Switch Controlled, Green Telltale, Ground
134	Purple/White	Fog Lamp on Warning Light
135	Dark Green/ White	Temperature Gauge Sender Controlled, Resistive Ground
136	Dark Blue	Vacuum Switch Controlled, Turbo Boost Telltale, Ground
137	White	Vacuum Switch Controlled, Turbo Economy Telltale, Ground
138	Red/White	Fused Battery Feed to Trunk Pull Down Motor
139	Pink/Black	Ignition Switch "On and Crank" Controlled, Fused Feed
140	Orange	Battery, Fused Feed
141	Brown/White	Ignition Switch, "Accessory and On" Controlled, Feed
142	Black	Rear Compartment Lid Lock Release
143	Pink	Radio Switch "On" Controlled Feed
144	Yellow	Power Antenna Switch Feed
145	Dark Green	Power Antenna Up, Relay Controlled Feed
146	Dark Green	Trunk Release Telltale Ground
147	Gray/Black	Driver Side Door Ajar Controlled Ground
148	Dark Blue/Red	Glove Box Release Solenoid, Switched Feed
149	Purple/Yellow	Courtesy Lamp(s), (Relay Controlled Ground)
150	Black	Direct Ground
151	Black	Direct Ground
152	Black	Direct Ground
153	Black	Direct Ground
154	Black	Direct Ground
155	Black	Direct Ground
156	White	Body Interior Lamps (Such as Dome, Courtesy, Map, Warning, Etc.), Switch Controlled Ground
157	Gray	Body Interior Lamps (Such as Dome, Courtesy, Map, Warning, Etc.), Switch Controlled Ground

* Low-Energy Circuit

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS (Cont'd)

Circuit Number	Circuit Color	Circuit Name
158	Black/Orange	Body Interior Lamps (Such as Dome, Courtesy, Map, Warning, Etc.), Switch Controlled Ground
159	Tan	Key Warning Buzzer Ground
160	White	Power Antenna Down
161	Gray	Power Antenna Up
162	Gray	Power Top-Up
163	Purple	Power Top-Down
164	Dark Blue	Window Control Left Front Up
165	Brown	Window Control Left Front Down
166	Dark Blue/ White	Window Control Right Front Up – Door Switch
167	Tan	Window Control Right Front Down – Door Switch
168	Dark Green	Window Control Left Rear Up
169	Purple	Window Control Left Rear Down
170	Light Green	Window Control Right Rear Up – Door Switch
171	Purple/White	Window Control Right Rear Down – Door Switch
172	Light Green	Vent Control Left Front Close
173	Yellow	Vent Control Left Front Open
174	Dark Green	Vent Control Right Front Close
175	Purple	Vent Control Right Front Open
176	Dark Green	Power Seat Fore
177	Yellow	Power Seat Aft or Recline
178	Dark Green	Power Seat – Six-Way – Fore and Aft
179	Tan	Power Seat – Six-Way – Rear – Up and Down
180	Light Green	Power Seat – Six-Way – Front – Up and Down
181	Light Blue	Power Seat – Fore and Aft
182	Yellow	Power Seat – Six-Way – Aft and Down
183	Light Blue	Tailgate or Center Partition Window Up
184	Tan/White	Tailgate or Center Partition Window Down
185	Tan	Vent Control Left Rear Open
186	Gray	Vent Control Left Rear Close
187	Dark Blue	Vent Control Right Rear Open
188	Light Blue	Vent Control Right Rear Close
189	Dark Green	Four-Way – Fore and Down
191	Light Green	Four-Way – Up and Down Power Seat
192	Purple	Defogger – High or Single Speed
193	Purple/White	Defogger – Low Speed – 0.38 Ohms per Foot
194	Black	Electric Door Lock – Unlock
195	Light Blue	Electric Door Lock – Lock
196	Yellow	Wiper Motor Feed – Park Switch Controlled
197	Red/Black	Defogger – Battery Fused Feed to Relay
198	Light Green/ Black	Air Conditioning In-Car Sensor Controlled, Resistive Ground
199	Brown	Rear Seat Speaker – Feed From Radio Left Stereo
200	Light Green	Front Speaker — Feed From Radio — Single or Right Stereo
201	Tan	Front Speaker – Feed From Radio – Left Stereo
202	Black	Compressor Over Heat Switch Controlled Ground
203	Light Blue	Rear Air Conditioning Potentiometer Feed
204	Dark Blue	Thermal Limiter Feed
205	White/Black	Seat Belt Seat Sensor to Belt Retractor, Ground
206	Dark Blue	Neutral Start Switch to Buzzer and Lamp
207	Yellow	Seat Sensor to Neutral Start Switch Lamp and Buzzer Ground
208	Gray	Switch Controlled Ground (TCS)
209	Purple	Park Brake Warning Lamp
210	White	Power Seat – Six-Way – Fore and Down
211	Dark Blue	Power Seat – Six-Way – Aft and Up
212*	Red	Keyless Entry Power Feed
213*	Dark Blue	Keyless Entry – Keypad Input 1
214*	Brown	Keyless Entry – Keypad Input 2
215*	Dark Green	Keyless Entry – Keypad Input 3
216*	White	Keyless Entry – Keypad Input 4
217*	Yellow	Keyless Entry – Keypad Input 5
218*	Purple	Keyless Entry – Audio Input
219*	Tan	Keyless Entry – Logic Ground
220*	Black/Light Green	D0 – CRT Data Signal
221*	Black/Tan	D1 – CRT Data Signal
222*	Black/Purple	D2 – CRT Data Signal
223*	Black/Yellow	D3 – CRT Data Signal
224	Light Blue	Scale Signal (Digital Fuel Gauge)
225	Red	Indicator Signal From Regulator (I)
226	Light Green	Trip Odometer (Digital Display)
231	Tan/White	Digital Oil Pressure Signal
233	Black/Tan	Park Brake to Alarm – Switched Ground
235	White/Black	Ign. Sw. to Alarm Module – Crank Signal
237	Yellow	Seat Belt Warning, Timer Controlled (Timed 39 Circuit) Feed
238	Black	Seat Belt Warning System, Belt Assembly to Buzzer Ground
239	Pink/Black	Ignition Switch, "On and Crank" Controlled, Fused Feed
240	Orange	Battery, Fused Feed
241	Dark Blue/ White	Relay Controlled "Accsy" Feed (D.A.B. Typically)
242	Tan	Throttle Control Spark Valve Controlled Feed
243	Black/White	Drive Selector Switch Controlled Feed
244	Purple	Left Front Door Solenoid, Relay Controlled Feed
245	Dark Blue	Right Front Door Solenoid, Relay Controlled Feed
246	Dark Green	Automatic Door Lock Relay Coil Feed
247	Brown	Air Conditioning Shut-Off Relay Feed
248	Dark Blue	Air Conditioning Compressor Harness Relay Controlled Feed

* Low-Energy Circuit

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS (Cont'd)

Circuit Number	Circuit Color	Circuit Name
249	Dark Green	From Air Conditioning Harness, Feed
250	Brown	Ignition Switched "On" Controlled, Fused Feed
252	Yellow	Automatic Door Lock Module Unlock Output Controlled Ground
253	Brown	Automatic Door Lock Output Controlled Ground
254	Light Green	Automatic Door Lock Left Unlock Relay Coil Ground
255	Yellow	Automatic Door Lock Right Unlock Relay Coil Ground
256	Dark Blue	Module Controlled, Lamp Out Indicator Ground
257	Brown	Air Conditioning Pressure Switch Controlled Ground
260	Black	Theft Deterrent – Hood Switch
261	Yellow	Theft Deterrent – Alarm Arm
262	Light Green	Theft Deterrent – Key – Door Unlock and Alarm Disarm
263	Light Blue	Theft Deterrent – Alarm
264	Dark Green	Theft Deterrent – Alarm Indication
265	Black/White	Theft Deterrent – Alarm Output
266	Pink	Theft Deterrent – Alarm Arm Abort
267	Dark Green	Power Seat – Fore and Up Recliner
268	Yellow	Power Seat – Aft and Down Recliner
269	Light Green	Power Seat – Solenoid Up and Down Recliner
270	Black/Yellow	Amplifier to Potentiometer, Feed
271	Purple	Potentiometer Controlled Ground
272	Light Green	Potentiometer Rheostat Controlled Feed
273	Orange	Headlamp Switch to Amplifier, Headlamp Switch Controlled Feed
274	Dark Green/ White	Headlamp Switch to Amplifier, Feed
275	Light Green/ Black	Neutral Safety Start Switch, "Park" Controlled Feed
276	Light Green	Power Seat Forward, Reclining Motor Feed
277	Light Blue	Power Seat Recliner, Recliner Motor Feed
278	White	Amplifier to Photocell
279	Black	Headlamp Switch to Photocell
280	Pink	Permanent Magnet Motor Up Cycle (Deck Lid Pull Down), Feed
281	White	Relay Coil Down Cycle (Deck Lid Pull Down), Ground
282	Yellow	Power Seat, Rear Vertical Up – Motor
283	Light Blue	Power Seat, Rear Vertical Down – Motor
284	Light Green	Power Seat, Aft Motor
285	Tan	Power Seat, Fore Motor
286	Dark Green	Power Seat, Front Vertical Up – Motor
287	Dark Blue	Power Seat, Front Vertical Down – Motor
288	Yellow/Black	Power Seat, Rear Vertical Up Relay
289	Light Blue/ Black	Power Seat, Rear Vertical Down Relay
290	Light Green/ Black	Power Seat, Aft Relay
291	Dark Blue	Heated Glass, Timer, On-Off Switch Controlled Ground
292	Light Blue	Heated Glass, Timer, On-Off Switched Controlled Feed
293	Purple/White	Heated Glass, Timer Controlled Feed
294	Tan	Door Lock Motor – Unlock
295	Gray	Door Lock Motor – Lock
296	Brown	Power Seat, Fore Relay
297	Gray	Power Seat, Front Vertical Up Relay
298	Purple	Power Seat, Front Vertical Down Relay
299	Light Blue	Seat Belt Warning System, Door Retractor Switched Ground
300	Orange	Ignition Switch, "On" Controlled – Unfused Feed
301	Brown/White	Headlamp on Warning 12 V Feed
302	White	Low Voltage – Sub Woofer System
303	Yellow	Gain Voltage – Sub Woofer System
304	Yellow/Black	Twilight Sentinel Enable
305*	Gray/Red	5 Volts Ref (CRT From Controller)
306	Dark Green	Potentiometer Controlled Dim Sensitivity – Guidematic
307	Yellow/Black	Hi to Lo Beam Switch – Flash-to-Pass Signal
308	Gray/Black	Park Lights On Sense Signal (Twilight Sentinel)
309	Brown/White	Right Inboard Tail Lamp Feed (Lamp Monitor)
310	Yellow/Black	Dimmer Switch Controlled Feed – Guidematic Enable
311	Light Green/ Black	Right Hi Beam Feed (Lamp Monitor)
312	Tan/White	Right Lo Beam Feed (Lamp Monitor)
313*	Light Green	Oil Pressure Sender Analog Signal
314	Light Blue/ Black	14 Volt Ref (Remote Tape Deck)
315	Light Blue/ Black	Sub-Woofer Spkr; Minus (–) Output & Radio Speaker Amplifier; Right Door Return
318	Yellow/Black	Relay Activated Left Directional Lamp
319	Dark Green/ White	Relay Activated Right Directional Lamp
320	White	Electronic Level Control – Exhaust Solenoid
321	Yellow	Electronic Level Control – Control Relay
322	Dark Green	Electronic Level Control – Compressor
325	Yellow	ECM to "Service Electrical System" Lamp
328	Purple	Photo Amplifier "High-to-Low" Beam Dim Output
329	Light Green/ Black	Radio Speaker Amplifier; Left Door Return
330	Light Green/ White	Radio Speaker Amplifier; Left Door Feed
331	Tan/White	Oil Pressure Transducer
332	Dark Blue/ Orange	CRT RE in From Controller
333	Tan	Low Brake, Vacuum Switch Controlled

* Low-Energy Circuit

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS (Cont'd)

Circuit Number	Circuit Color	Circuit Name
334	Black/Light Blue	CRT Wake-Up Signal From Controller
335	Dark Green/ White	Electric Cooling Fan Relay – Coil Ground (A/C or Engine Temperature)
338	Purple/White	Guidematic Power Relay Coil Feed – Photo Amplifier Controlled
339	Pink/Black	Ignition Switch, "On and Crank" Controlled, Fused Feed
340	Orange	Battery – Fused, Feed
341	Brown	Switched Feed – Engine Speed Sensor to Step Speed Control Solenoid
342	Light Green	"On and Off" Controlled – Unfused
343	White	"On and Off" Controlled – Fused
344*	Red/Black	Keyless Entry Switch Pad Feed From Module
346	Dark Blue/ White	Sub-Woofer Spkr; Plus (+) Output & Radio Speaker Amplifier; Left Door Feed
350	Pink/White	Ignition Switch "On" Controlled, Fused Feed
351	Dark Blue	Lamp Feed From Electroluminescence Inverter
352	White	Lamp Ground to Electroluminescence Inverter
356	Gray	Analog "Pmdl" Signal From TMNSS
357*	Red	Feedback Signal From EVRV
359	Purple/Yellow	Front Right Park Lamp Feed (Lmp Monitor)
360	Orange	Amplifier Feed – Relay Controlled Bose Speaker System
361	Purple	Push Button Air Cond. Bi-Level 12 V Feed
362	Red	Push Button Air Cond. Heater
363	Tan	Push Button Air Cond. Defrost
366	Light Green/ Black	Air Conditioning, Cut Out Switch Controlled
367*	Brown/White	Left Audio Signal (Remote Tape Deck)
368*	Dark Green/ White	Right Audio Signal (Remote Tape Deck)
370	Pink	Automatic Vehicle Leveling, Feed
371	Black/Orange	Lo Ground (Remote Tape Deck)
372	Black/White	Hi Ground (Remote Tape Deck)
374	Brown	Fuel Used Signal (Digital Display)
375	Pink	Fuel Readout Reset (Digital Display)
376	Light Green	Trip Reset (Digital Display)
377	Purple	Diagnostic Enable (Digital Display)
381	Red	3-Mode Electronic Cruise – Cruise Speed Signal
382	Light Blue/ Black	Low Vacuum Switch to Four Wheel Drive Relay, Feed
383	Light Blue	Convert Clutch Release Switch to Vacuum Switch
384	Light Green	Vacuum Switch to Transmission Switch Solenoid
385	Purple	High Vacuum Switch to Transmission Switch Solenoid
386	Yellow	EGR Bleed Solenoid to TCC Pressure Switch
387	Orange	TCC Pressure Switch to Transmission Solenoid
388	White	TCC Coolant Switch to Low Vacuum Switch
389	Dark Green	3-Mode Electronic Cruise – Speedo Speed Signal
390	Tan	Side Marker and License Lamp Feed (Export)
391	Gray	Rear Window Wiper Low
392	Dark Green	Rear Window Wiper Switch to Washer, Feed
393	White	Rear Window Wiper Feed
394	Light Green/ Black	Left Front Door Remote Handle Switch Controlled Ground
395	Light Blue	Right Front Door Remote Handle Switch Controlled Ground
96	Light Blue/ Black	Park Selector Switch – Controlled Feed
397	Gray	3-Mode Electronic Cruise – "On/Off" Column Switch
398	Tan	3-Mode Electronic Cruise – Servo. Position Sensor – High
399	Light Blue/ Black	3-Mode Electronic Cruise – Servo. Position Sensor – Low
400	Yellow	3-Mode Electronic Cruise – Speed Sensor – High
401	Purple	3-Mode Electronic Cruise – Speed Sensor – Low
402	Light Green	Electronic Cruise Control Vacuum Valve Feed
403	Dark Blue/ White	Electronic Cruise Control Vent Valve Feed
404*	Light Green	EST Pickup Coil to HEI Module, High
405*	White	EST Picxkup Coil to HEI Module, Low
406*	White/Dark Green	ESC Module to HEI Module, Signal Lead
407*	Black	ECM to HEI Module, EMR Signal Lead
408*	Tan/White	ECM to ESC Bypass
409	Light Blue/ Black	Coolant Fan Control Fused Feed
410*	Yellow	ECM to Coolant Temperature Sensor
411	Light Blue	ECM to Fuel Metering Solenoid
412*	Purple	Oxygen Sensor Signal
413*	Tan	Oxygen Sensor Low
414	Pink	Oxygen Sensor Heater High
415	Light Green	ECM to Ennchment Switch
416*	Gray	ECM 5 Volt Reference Voltage
417*	Dark Blue	ECM to Throttle Position Sensor Signal
418	Brown	ECM to Adaptive Switch
419	Brown/White	ECM to "Chck Engin" Lamp ("Hard" Failure)
420	Purple	ECM to Brake Switch
421	Dark Blue/ White	ECM to Cold Start Program Modifier
422	Tan/Black	ECM to TCC Solenoid
423*	White	EST Signal

* Low-Energy Circuit

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS (Cont'd)

Circuit Number	Circuit Color	Circuit Name
424*	Tan/Black	EST Bypass
425	Light Blue	ECM to ISC Motor Extend
426	Dark Blue	ECM to ISC Motor Retract
427	Pink	ECM to ISC Switch
428	Dark Green/ Yellow	ECM to Canister Purge
429	Black/Pink	ECM to Air Control Solenoid
430*	Purple/White	EST Reference Pulse High
431	Light Green/ Black	8 Volt Reference Voltage
432*	Light Green	ECM to Map Signal
433*	Gray/Black	ECM to Baro Signal
434	Orange/Black	ECM to Park/Neutral Switch
435	Gray	ECM to EGR Solenoid
436	Brown	ECM to Air Switch Solenoid
437	Brown	ECM to Vehicle Speed Sensor
438	Dark Green/ White	ECM to High Gear Switch
439	Pink/Black	Ignition Switch "On and Crank" Controlled, Fused Feed
440	Orange	Battery, Fused Feed
441	Light Blue/ White	Electronic Control Module to Idle Air Control, Coil A, High
442	Light Blue/ Black	Electronic Control Module to Idle Air Control, Coil A, Low
443	Light Green/ White	Electronic Control Module to Idle Air Control, Coil B, High
444	Light Green/ Black	Electronic Control Module to Idle Air Control, Coil B, Low
445	Gray/Red	Electronic Control Module to Early Fuel Evaporation Solenoid
446	Light Blue	Electronic Control Module to Fourth Gear Switch
447	White/Dark Blue	Throttle Body Injection Back-Up Mode Select, Electronic Control Module to Electronic Control Module
448	Red	Relay Switched Injector Feed
449	Brown	Conditioning Clutch Relay, Air Conditioning Wide Open Throttle Cut Out, ECM to Air
450	Black/White	Ground, ECM
451	White/Black	Diagnostic Enable
452*	Black	Ground, Low Level
453*	Black/Red	EST Reference Pulse Low
454*	Black/White	Critical Ground Circuit
455*	Purple	Electronic Control Module to Map Sensor, Ground
456	Tan/Black	ECM to Upshift Lamp
457*	Yellow/Black	ESC Controller Half-Function Output to ECM
458	Red	Fuel Pump Feed, Relay Switched, Unfused
459	Dark Green/ White	AC Compressor Relay Computer Control
460	Black/Orange	Circuit Breaker Protected Battery Feed
461	Orange	ECM to ECC, Serial Data for MPG or Diagnostics
462	Pink/Black	ECM, Set Timing, Ground
463	Black/Orange	ECM to Trip Computer Signal, Fuel Flow Data (Injector On Time)

Circuit Number	Circuit Color	Circuit Name
464	Tan/Black	MPG Reset Signal
465	Dark Green/ White	Electric Fuel Pump Relay Feed
466	Gray	Buffered Signal to Trip Calculator – Speed Data
467	Light Blue	Low Side of Injector "A", ECM Controlled
468	Light Green	Low Side of Injector "B", ECM Controlled
469*	Black/Orange	Map Return, Low Level Ground
470*	Black	Ground, Low Level
472*	Tan	Manifold Air Temperature Signal
474*	Gray	5 Volt Reference Voltage
476*	Black/Pink	Throttle Position Sensor Return, Low Level, Ground
477	Brown	MPG Request Signal
478	Purple	Fuel Economy Indicator (Green), IMC Controlled
479	Light Green/ Black	Fuel Economy Indicator (Amber), IMC Controlled
480	Orange	ECM Battery Controlled, Fused Feed
481	Red	Injector "A", Fused Feed
482	White	Injector "B", Fused Feed
483*	Light Green	ESC or ESS Reference Pulse High
484*	White	ESC or ESS Reference Pulse Low
485*	Black	ESC or ESS Signal
486*	Brown	ESC or ESS Distributor Ground
487*	White/Dark Green	Electronic Control Module to Remote Lamp Driver
488	Light Green	Remote Lamp Driver to Assembly Line Data Link
489	Yellow	Remote Lamp Driver to Check Engine Lamp
490	Red	Fuel – Pump Prime – Feed
491*	Orange	BCM to ECM Serial Data – For MPG or Diagnostics
492	Yellow	Mass Air Flow Sensor – Signal to ECM
493*	Gray	ECM Fuel Calibration Jumper
494	Yellow	TCC Signal – 3 Mode Cruise Module From ECM
495	Light Blue/ Orange	ECM to Power Steering Cutout Switch
496*	Dark Blue	ESC Detonation Sensor Input
497	Light Green	Electric Fuel Pump Relay, Return
498*	Yellow	Tip-In Vacuum Switch to the Electronic Spark Control
499	Gray/Black	ECM to "Service Engine Soon" Lamp ("Soft" Failure)
500	Black/White	Module to PTC, Ground Plane
501	Purple	Secondary PTC Sensor
502	Gray	Primary PTC Sensor
503	Orange	Glow Plug, Sensor or Feed
504	Brown/White	Voltage Regulator Control (Diode Isolated), Feed
505	Yellow	Glow Plug Relay, Feed
506	Light Blue	Glow Plug Relay, Return
507	Dark Blue	Diesel Wait Lamp
508	Yellow/Black	"Water-in-Tank" Indicator, Switched Ground
509	Orange/Black	Glow Plug, Passenger Side, Sense or Feed

* Low-Energy Circuit

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS (Cont'd)

Circuit Number	Circuit Color	Circuit Name
510*	Yellow	Coolant Temperature Sensor – Elec. Cluster
511*	Tan	Lt Frt Spkr Feed – Delco/Bose System
512*	Light Green	Rt Frt Spkr Feed – Delco/Bose System
513*	White	Audio Return Amplifier to Receiver – Bose II System
514*	Bare Core	Drain Wire for Delco/Bose System II
515*	Light Blue	Rt Rr Spkr Return – Delco/Bose System
516*	Yellow	Lt Rr Spkr Return – Delco/Bose System
517*	Dark Green	Rt Frt Spkr Return – Delco/Bose System
518*	Gray	Lt Frt Spkr Return – Delco/Bose System
519	Light Blue/ Black	Tail Lamp "Out" Indicator (Lmp Monitor)
520	White	ECM to TCC Conn Transmission Fluid Temp Signal
521	White	Engine RPM Sensor Input to DEC (Diesel Engine Control)
522	White	Left Outer Stop/Turn Lamp Feed (Lmp Monitor)
523	Pink	Left Inner Stop/Turn Lamp Feed (Lmp Monitor)
524	Purple	Right Outer Stop/Turn Lamp Feed (Lmp Monitor)
525	Yellow	Right Inner Stop/Turn Lamp Feed (Lmp Monitor)
526*	Brown	ECM to BCM Serial Data – for MPG and Diagnostics
529	Dark Green/ Yellow	Park Lamp "Out" Indicator (Lmp Monitor)
530	White	Diode Module/Control Relay Glow Plug Controller
531	Light Green/ Black	Engine Temperature Switch -- Cold Advance Solenoid
532	Black/Red	Coolant Fan Relay – Coolant Fan (Single or Low)
533	Black/Pink	Coolant Fan Relay – Coolant Fan (High)
534	Dark Green	Fast Idle Solenoid
535	Dark Green	Coolant Temp. & A/C Pressure Switch – Fan Relay (Low)
536	Light Green/ Black	Coolant Temp. & A/C Pressure Switch — Fan Relay (High)
537	Light Green/ Black	Temp. Input to DEC, Ground Switch
538	Dark Green	DEC to EPR (Exhaust Pressure Regulator) Solenoid, Ground
539	Dark Blue/ Yellow	Headlamp "Out" Indicator
540	Orange	Battery Feed – Fusible Link Protected
541	Dark Green	Switched Feed — Engine Speed Sensor to Vacuum Advance Solenoid
545	Black/Pink	Electric EFE Heater Feed
546*	Dark Blue	Rt Rr Spkr Feed — Delco/Bose System

Circuit Number	Circuit Color	Circuit Name
549	Purple/White	Stop Lamp "Out" Indicator (Lmp Monitor)
550	Black/Orange	Ignition Switch Controlled – Elec. Cluster Check
551	Tan/White	ECM to Engine Ground (Redundant Ground)
552*	Black	Low Level Ground – Elec. Cluster
553	Tan/White	Voice Active Signal (Vocal Warning System)
555	Dark Blue/ White	CPS Wake Up Signal
558	Orange/Black	Fuel Economy Signal (Digital Display)
559	Pink/Black	Voice Repeat (Vocal Warning System)
560	Tan	Diesel ECM to Fuel Stepper A_1
561	Red	Diesel ECM to Fuel Stepper A_2
562	Orange	Diesel ECM to Fuel Stepper B_3
563	Yellow	Diesel ECM to Fuel Stepper B_4
564	Tan/Black	Diesel ECM to Timing Stepper A_1
565	Red/Black	Diesel ECM to Timing Stepper A_2
566	Orange/Black	Diesel ECM to Timing Stepper B_3
567	Yellow/Black	Diesel ECM to Timing Stepper B_4
572	Red/Black	Voice On/Off (Vocal Warning System)
575	Yellow	Anti-Theft Controlled Starter Solenoid Feed
583	Light Blue/ Black	Brake Switch – T.C.C. Solenoid
587	White	Relay Controlled Idle Speed Circuit
588	Brown	16 Volts for Vacuum Fluorescent Displays
590*	Light Blue/ Yellow	Sun-Load Sensor Signal
594*	Light Green	Graphic Equalizer – Channel 1 (60 HZ)
595*	Dark Green	Graphic Equalizer – Channel 2 (260 HZ)
596*	Dark Blue	Graphic Equalizer – Channel 3 (1 KHZ)
597*	Light Blue	Graphic Equalizer – Channel 4 (3.5 KHZ)
598*	Tan	Graphic Equalizer – Channel 5 (10 KHZ)
599*	Brown	Lt Rr Spkr Feed – Delco/Bose System
600*	Brown	Graphic Equalizer – On/Off Switch
601	Dark Blue	Frt Spkr Feed From Module Asm – Voice Output Alarm
602*	Dark Green/ White	Electronic Cluster Engine Hot Output
605*	Light Green/ Black	Graphic Equalizer, + 5 Volts Ref.
606	Dark Green/ Orange	Radio Mute (Remote Tape Deck)
607	White/Dark Green	Tape "On" Signal (Remote Tape Deck)
608	Dark Green/ Yellow	8 Volt Ref (Remote Tape Deck)
609	White	Right Tail Lamp Feed/Monitoring
610	Tan	Power Seat – Six-Way – Fore and Down, Relay to Motor

* Low-Energy Circuit

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS (Cont'd.)

Circuit Number	Circuit Color	Circuit Name
611	Light Blue	Power Seat – Six-Way – Aft and Up, Relay to Motor
612	Black	Reverse – Memory Seat
613	Gray	Memory Seat Module Feed
614	Orange	Seat Circuit – Memory Seat
615	White	Memory I – Memory Seat
616	Purple	Memory II – Memory Seat
617	Brown	Drive – Memory Seat
618	Yellow/Black	Left Side Trailer and Direction, Feed
619	Dark Green/ White	Right Side Trailer and Direction, Feed
620	Brown	Theft Deterrent, Alarm Arm, Left Front Door Switch Output
621	Yellow	Theft Deterrent, Alarm Arm, Right Rear Door Switch Output
622	Brown	Theft Deterrent, Alarm Arm, Right Rear Door Switch Output
623	Dark Blue	Alarm Arm, Manual
625	Black/Yellow	Theft Module to Starter Interlock Relay Ground Signal
626*	Dark Green/ Orange	Radio Mute (Voice Module to Radio)
627	White	Tachometer Indicator
628	Gray/Black	Lt Frt Stereo Spkr, Return to Alarm or Voice Module
630	Black	C3I Ref Signal to ECM
631	Yellow	Cam Sensor Feed (C3I System)
632	Black/Pink	Cam Sensor Return (C3I System)
633	Brown/White	Cam Sensor Output Signal (C3I System)
635	Dark Green/ White	Digital Cluster Engine Coolant Temp. Signal
636*	Black/Orange	Graphic Equalizer, + 5 Volt Return
639	Pink/Black	Ignition Switch "On and Crank" Controlled, Fused Feed
640	Orange	Battery – Fused Feed
641	Black/Light Green	Crank Sensor Feed (C3I System)
642	Black/Yellow	Crank Sensor Return (C3I System)
643	Dark Blue/ White	Crank Sensor Output Signal (C3I System)
651	Purple/Yellow	Chime Module Input, BIT 1
652	Purple/White	Chime Module Input, BIT 2
660	Orange/Black	Battery, Circuit Brkr Protected, Feed
661	Orange/Dark Blue	Battery, Circuit Brkr Protected, Feed
663	Light Blue/ Black	Left Turn Signal Switch Output (To BCM Typ.)
664	Dark Blue/ White	Right Turn Signal Switch Output (To BCM Typ.)
665	Light Green	Hazard Signal Switch Output (To BCM Typ.)
666	Dark Blue	Window Control Right Front Up, Passenger Switch
667	Brown	Window Control Right Front Down, Passenger Switch
668	Dark Blue	Window Control Left Rear Up, Left Rear Switch
669	Brown	Window Control Left Rear Down, Left Rear Switch
670	Dark Blue	Window Control Right Rear Up, Right Rear Switch
671	Brown	Window Control Right Rear Down, Right Rear Switch
676	Pink/White	Heated Outside Mirror Fused Feed
681	Purple	Rear Defog Switch Output (To BCM Typ.)
682	Light Blue	Front Defog Switch Output (To BCM Typ.)
683	Tan	Rear Defog "On" LED Signal
684	Dark Blue	Front Defog "On" LED Signal
685	Brown/Yellow	Dome Lamp "On" Switch Output
686	Tan/Black	Panel Lamp Dim Signal
687	Dark Blue	High Gear Transmission Ground, Activates Speed Control Relay
690	Gray/Black	Courtesy Lamp Relay Coil Control Sig.
691	Black/Red	Headlamp Relay Coil Control Signal
692	Black/Pink	Relay Coil(s) Control (Twi Sent. System)
694	Tan	Driver Door Unlock Signal (Keyless Entry System)
700	White	CRT Video Signal From Controller
701*	Black	Data Link Ground (Remote Radio Chassis)
702	Black/Red	Cooling Fan Power Motor Feed
703	Dark Blue/ White	"Isolated" Ignition "On and Crank" Controlled, Unfused Feed (I1)
704	Purple/White	"Isolated" Ignition "On" Controlled, Unfused Feed (I3)
705*	Tan	BCM – 5 Volt Reference Voltage
706*	Light Blue	ECC Control – Warmer
707*	Black	Delayed Accessory Buss – Relay Coil Control Signal
708*	Red	ECC Control – Warmer
709	Purple	Left In-Board Tail Lamp Feed (Lmp Monitor)
710*	Yellow	BCM to Coolant Temp Sensor
711	Dark Green/ White	Left Hi Beam Feed (Lamp Monitor)
712	Yellow/Black	Left Low Beam Feed (Lamp Monitor)
713*	Yellow	BCM – Logic Clock (BCM, CCP, FDC, ECC and Cluster)
715	Yellow	Fuel Range Signal (Digital Display)
716	Orange/Black	16 Volt Reference Voltage
717	Gray/White	Intensity Control Signal for Incandescent Display
718*	Dark Blue/ White	BCM to CCP Serial Data
719*	Purple	BCM to FDC Serial Data
720*	Light Blue	BCM to ECC Programmer Serial Data
721	White	Service A/C System Telltale – "Low Refrigerant"
722*	Yellow	VRT Vertical Sync Signal
723*	White/Black	CRT Horizontal Sync Signal
724	Purple/Yellow	VF Dimming Signal (PWM)
729	Gray	Left Outer Tail Lmp Feed (Lmp Monitor)
731*	Gray	A/C Cmpr Refrigerant Pressure Switch Signal
732*	Dark Blue	A/C Cmpr Refrigerant Temp SW Signal

* Low-Energy Circuit

ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS (Cont'd.)

Circuit Number	Circuit Color	Circuit Name
733*	Light Blue	Air Mixture Door Position Sense Signal
734*	Dark Green	Ambient Air Inside Temp Sense Signal
735*	Light Green/ Black	Ambient Air Outside Temp Sense Signal
736*	Black/Pink	BCM – 5 Volt Return (Low Level From Sensors)
738	Light Green	"Wake-Up" Signal for CRT Controller
740	Orange	Battery – Fused Feed
743	Dark Green/ White	Ignition "On and Accsy" Controlled, Fused Feed
750	Pink/Black	"Isolated" Ignition "On" Controlled, Fused Feed
751	Black/White	BCM – Power Ground Direct
754	Gray/Black	Blower Enable Signal (PWM)
755	Gray	Automatic Seat Belt, Switch Controlled Ground
756	Dark Green/ White	Vacuum Solenoid Controlled Feed (For Electronic Distributor)
757	Yellow	Automatic Seat Belt Motor Feed
758	Light Green	Automatic Seat Belt Motor Forward (Ground)
759	Dark Green	Automatic Seat Belt Motor Rearward (Ground)
760*	Purple/White	BCM to A/C Control Module – Blower on Control Signal
761	Orange	A/C Control Module to BCM – Blower on Feedback Signal
762*	Dark Green/ Yellow	A/C Compressor Clutch Enable/ Disable Control Signal
771	Black/White	Digital 'Prndl' – 'A' Input From Trans. Switch
772	Yellow	Digital 'Prndl' – 'B' Input From Trans. Switch
773	Gray	Digital 'Prndl' – 'C' Input From Trans. Switch
774*	Dark Blue/ White	Digital 'Prndl' – Serial Data Signal
775*	Light Green/ Black	Digital 'Prndl' – Clock Signal
776	White	Digital 'Prndl' – Parity Signal
778	Black/White	Memory Seat/Mirror System Ground
779	Purple/White	Front Left Park Lamp Feed (Lmp Monitor)
780	Orange/Blue	Memory Seat/Mirror System, Power Feed
781	Yellow	Memory Seat System, Transmitter Feed
782	Black	Memory Seat/Mirror System, Logic Ground
783	Pink	Memory Seat/Mirror System, Serial Data
784	Dark Green	Left Outside Mirror, Vertical Position Sense
785	Light Blue/ Black	Right Outside Mirror, Horizontal Position Sense
786	Gray	Left Outside Mirror, Horizontal Position Sense
787	Brown	Right Outside Mirror, Vertical Position Sense
788	Dark Blue	Feed, Outside Mirror Position Sensors
790*	Brown	BCM to Fan Control Mod Electric Cooling Fan(s) on Signal
791*	Dark Green	Fan Control Module to BCM – Electric Cooling Fan(s) on Feedback Signal
800*	Tan	UART Data Link
801	Black/Red	Device Ground to CPS (Electronic Modules, Typ.)
803	Black/White	Single Point Ground ("Clean" Gnd for Electronics, Typ.)
804	Black	Isolated Body Ground ("Dirty" DND for Body, Typ.)
805	Yellow	On and Crank Controlled, Fused Feed
806	Purple/White	"Crank" Controlled, Fused Feed
807	Purple/White	7 Volts Ref from CPS
809	Dark Blue	Left Tail Lamp Feed/Monitoring (Inboard)
810	Tan	Distributor Electronics Controlled
811	Light Blue	Metric Conversion Signal – Digital Display
812	Red/White	"Conditioned" Battery From CPS (12V Ref)
820	Yellow	Center High Mounted Stop Lamp
825	Dark Blue	Electronic Brake Control to Booster (ABS Fail)
826	Black/White	Electronic Brake Control to Booster (LF Valve Ground)
827	Brown/White	Electronic Brake Control to Booster (RF Valve Ground)
828	Dark Green/ White	Electronic Brake Control to Booster (LR Valve Ground)
829	Dark Blue/ White	Electronic Brake Control to Booster (RR Valve Ground)
830*	Light Blue	Electronic Brake Control to Booster + LF Wheel Sensor
831*	Dark Blue/ Gray	CRT Latch From Controller
832	Tan	Cold Start Injector to Cold Start Injector Switch
833*	Tan	Electronic Brake Control to – RF Wheel Sensor
834*	Light Green/ Black	Electronic Brake Control to Booster, MV Signal
835*	Dark Green	Serial Data Link (Remote Radio Chassis)
836*	Black/Orange	5 Volt Return (CRT to Controller)
837	Light Blue/ Purple	Electronic Brake Control to Booster (Pressure Warning)
838	Dark Blue/ White	VF Power "Wake-Up" Signal
839	Pink/Black	Ignition Switch "On and Crank" Controlled Fused Feed
840	Orange	Battery, Fused Feed
841	Black	SFI Injector 1 Control Sig.
842	Black/Light Green	SFI Injector 2 Control Sig.
843	Black/Pink	SFI Injector 3 Control Sig.
844	Black/Red	SFI Injector 4 Control Sig.
845	Black/White	SFI Injector 5 Control Sig.

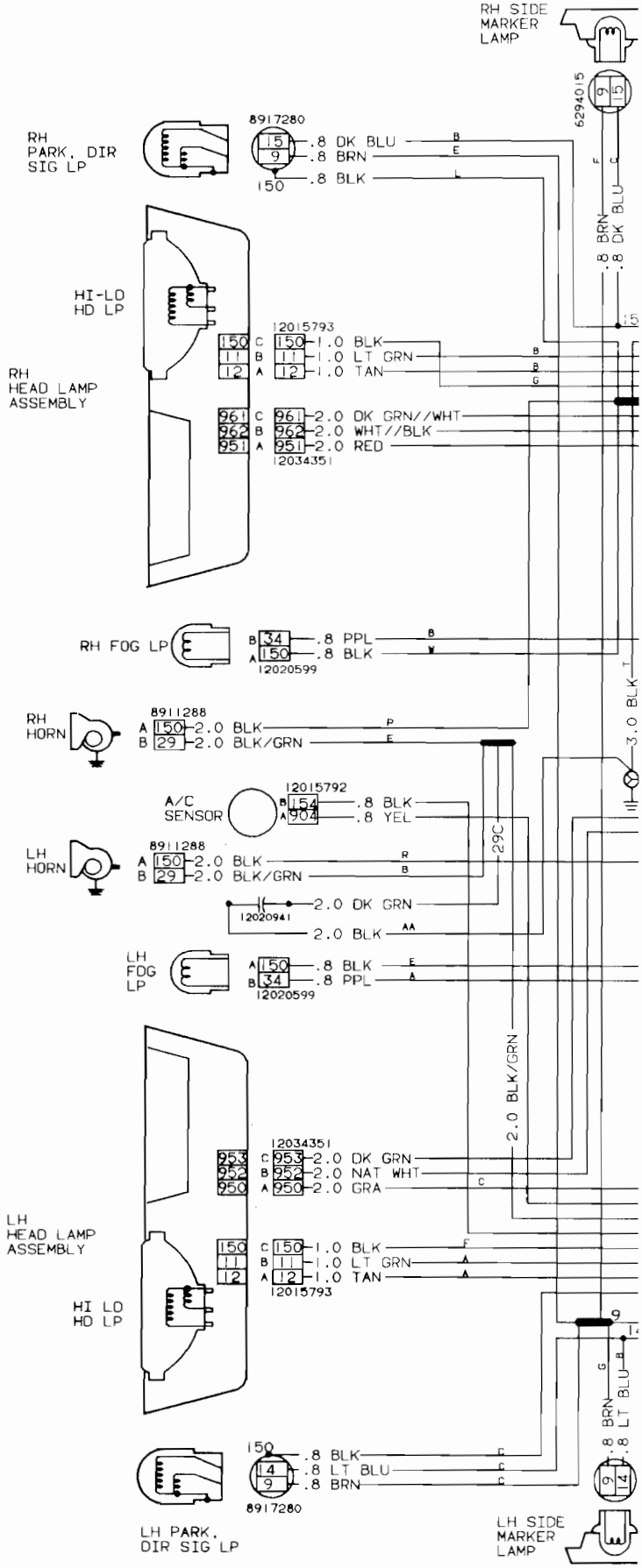
* Low-Energy Circuit

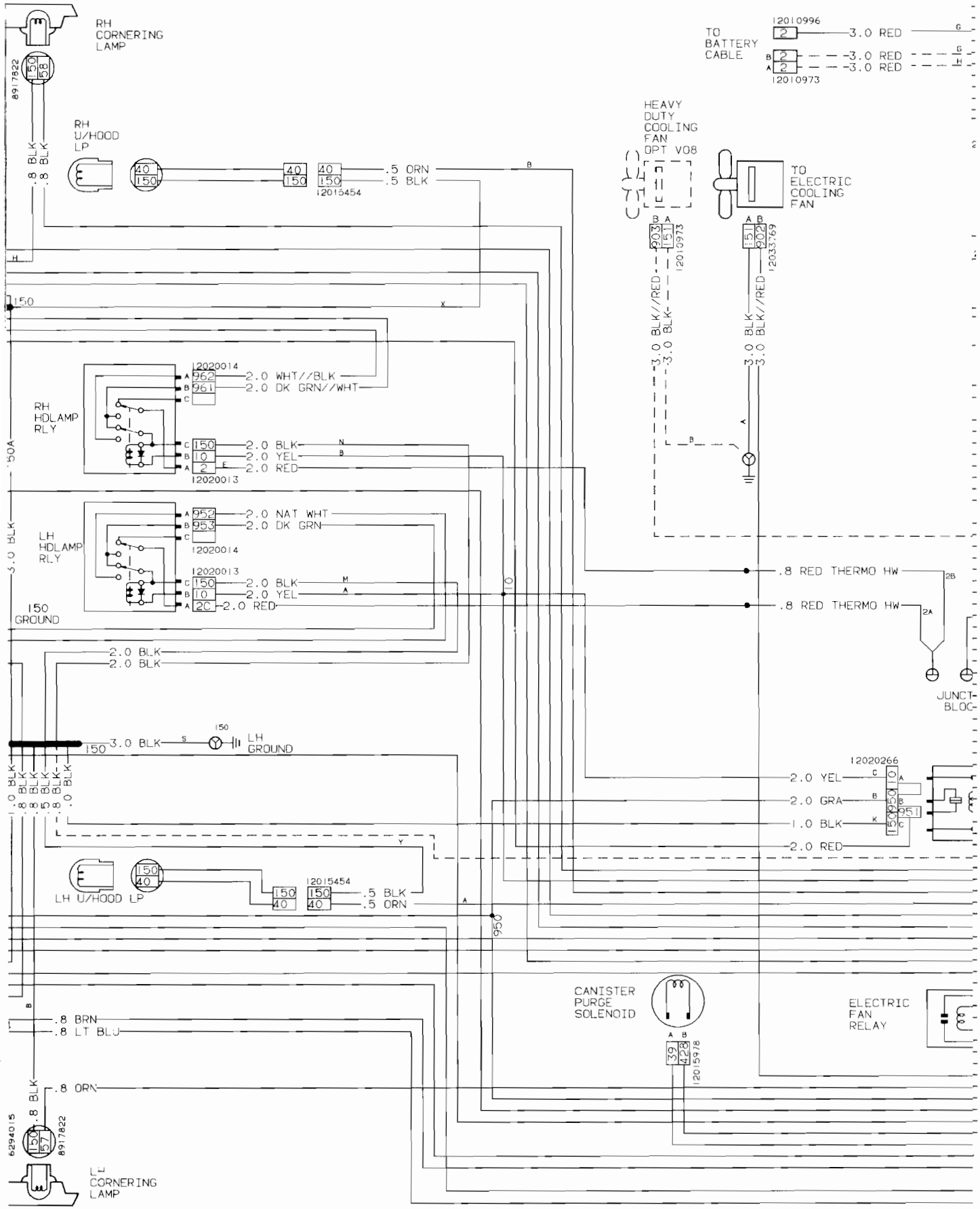
ELECTRICAL CIRCUIT IDENTIFICATION FOR WIRING DIAGRAMS (Cont'd.)

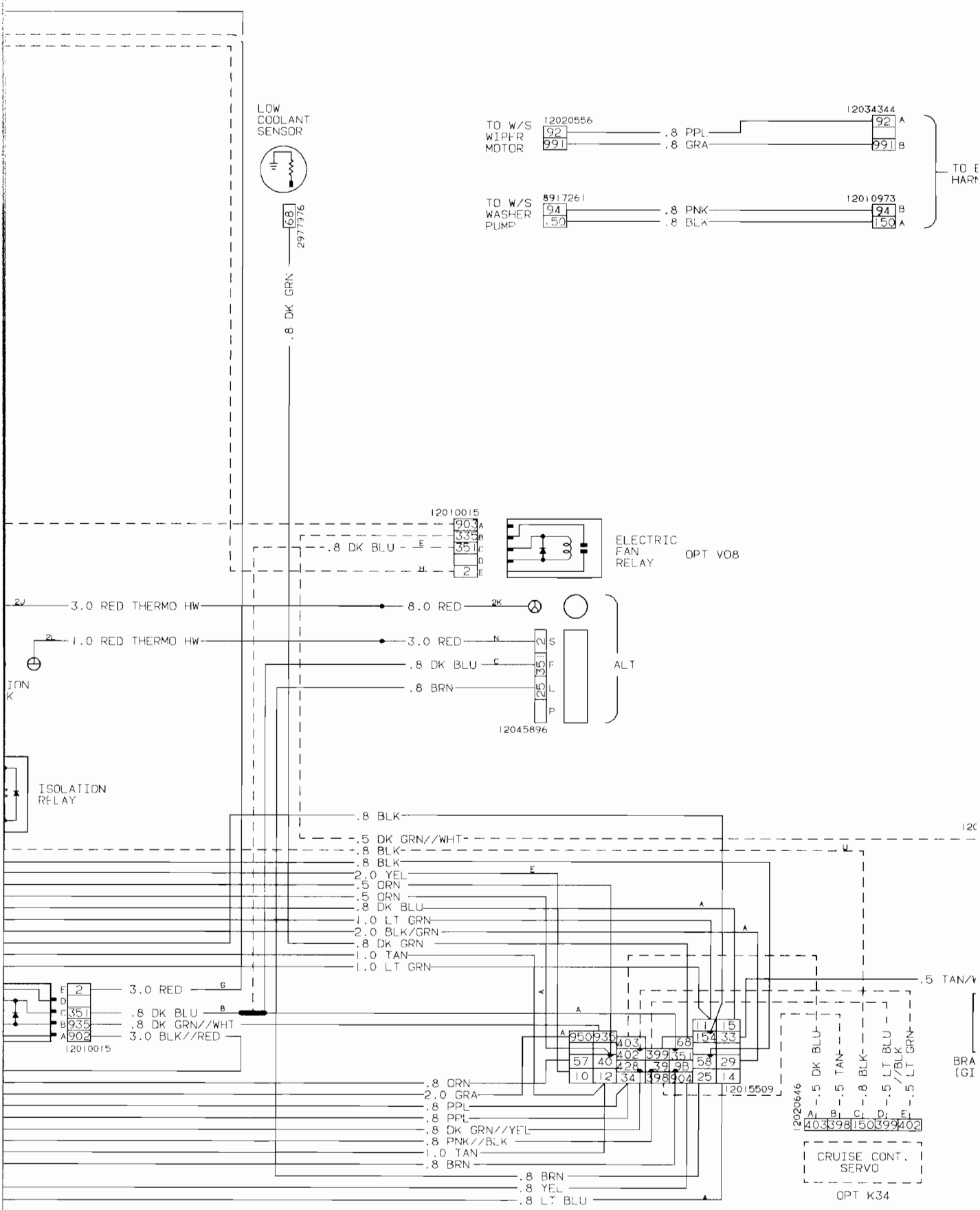
Circuit Number	Circuit Color	Circuit Name
846	Black/Yellow	SFI Injector 6 Control Sig.
847	Gray	Electronic Brake Control to Booster (Control Switch)
848	Tan	Electronic Brake Control to Booster (Pedal Distance)
849*	Pink	Electronic Brake Control to Booster (Reference)
850	Red/White	Electronic Brake Control to Booster Overvoltage Relay Battery Switched
851	Gray/Black	Electronic Brake Control to Booster Relay
852	Gray/White	BCM/Cluster to Booster – Brake Telltale
853	Light Blue/Red	BCM to Fluid Level
854	Pink/White	Electronic Brake Control to Booster Relay
860	Dark Green	Battery, Circuit Brkr Protected, Feed
868	Dark Green	Window Control Left Rear Up, Relay to Motor
869	Purple	Window Control Left Rear Down, Relay to Motor
870	Light Green	Window Control Right Rear Up, Relay to Motor

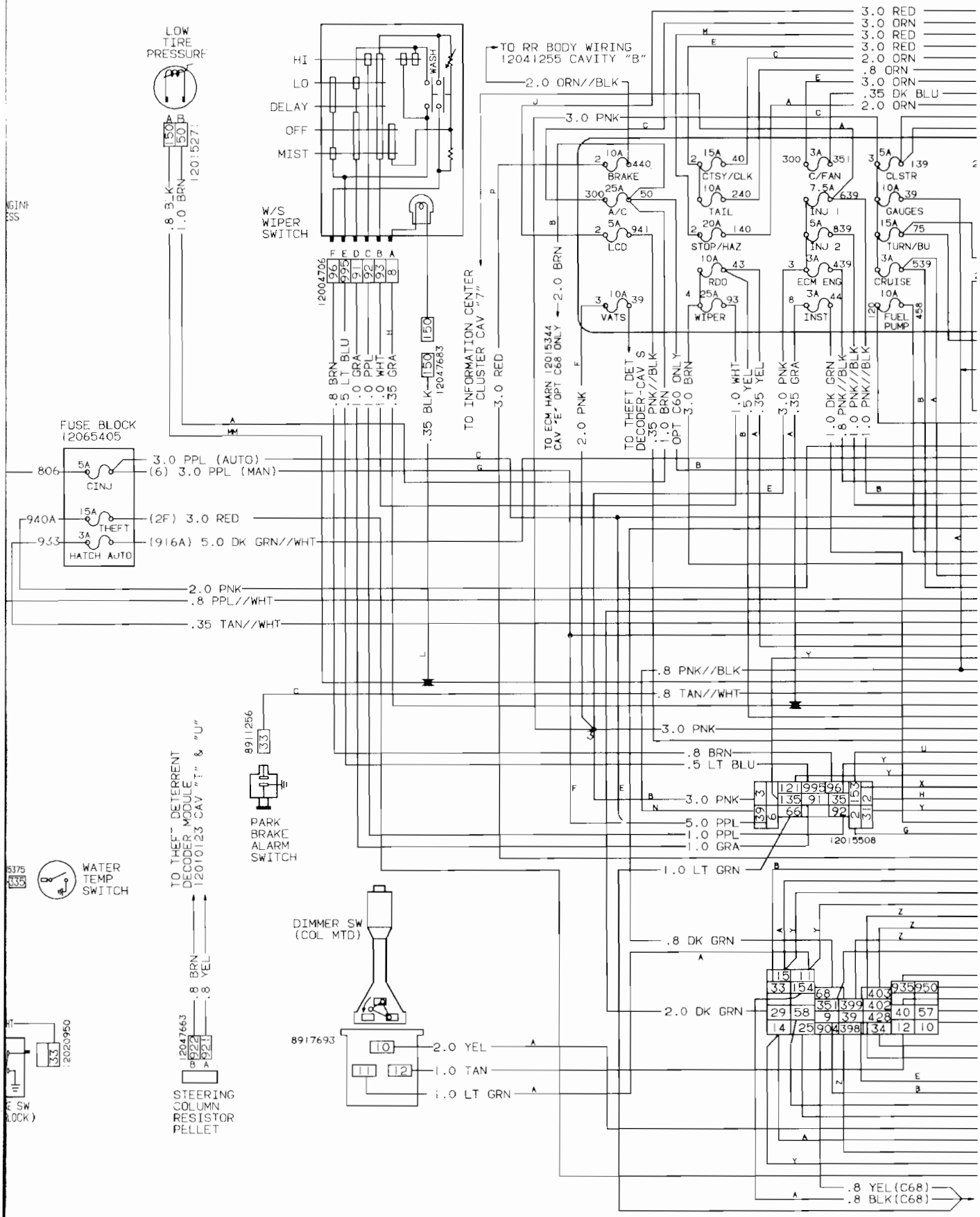
Circuit Number	Circuit Color	Circuit Name
871	Purple/Double White	Window Control Right Rear Down, Relay to Motor
872*	Dark Green	Electronic Brake Control to + RF Wheel Sensor
873*	Yellow	Electronic Brake Control to – LF Wheel Sensor
879	Purple/White	Electronic Brake Control to Booster, Relay Drive
880	Orange	Fuseblock to OV Relay/Stop SW
881	Red/White	Electric Remote Mirror, Motion "Right" Passenger Door Only
882*	Brown	Electronic Brake Control to + RR Wheel Sensor
883*	White	Electronic Brake Control to – RR Wheel Sensor
884*	Black	Electronic Brake Control to + LR Wheel Sensor
885*	Red	Electronic Brake Control to – LR Wheel Sensor
886	Purple	Electronic Brake Control to Booster (Shaft Distance)
889	Purple/White	Electric Remote Mirror, Motion "Down" (Passenger Door Only)
899		Diode – Any

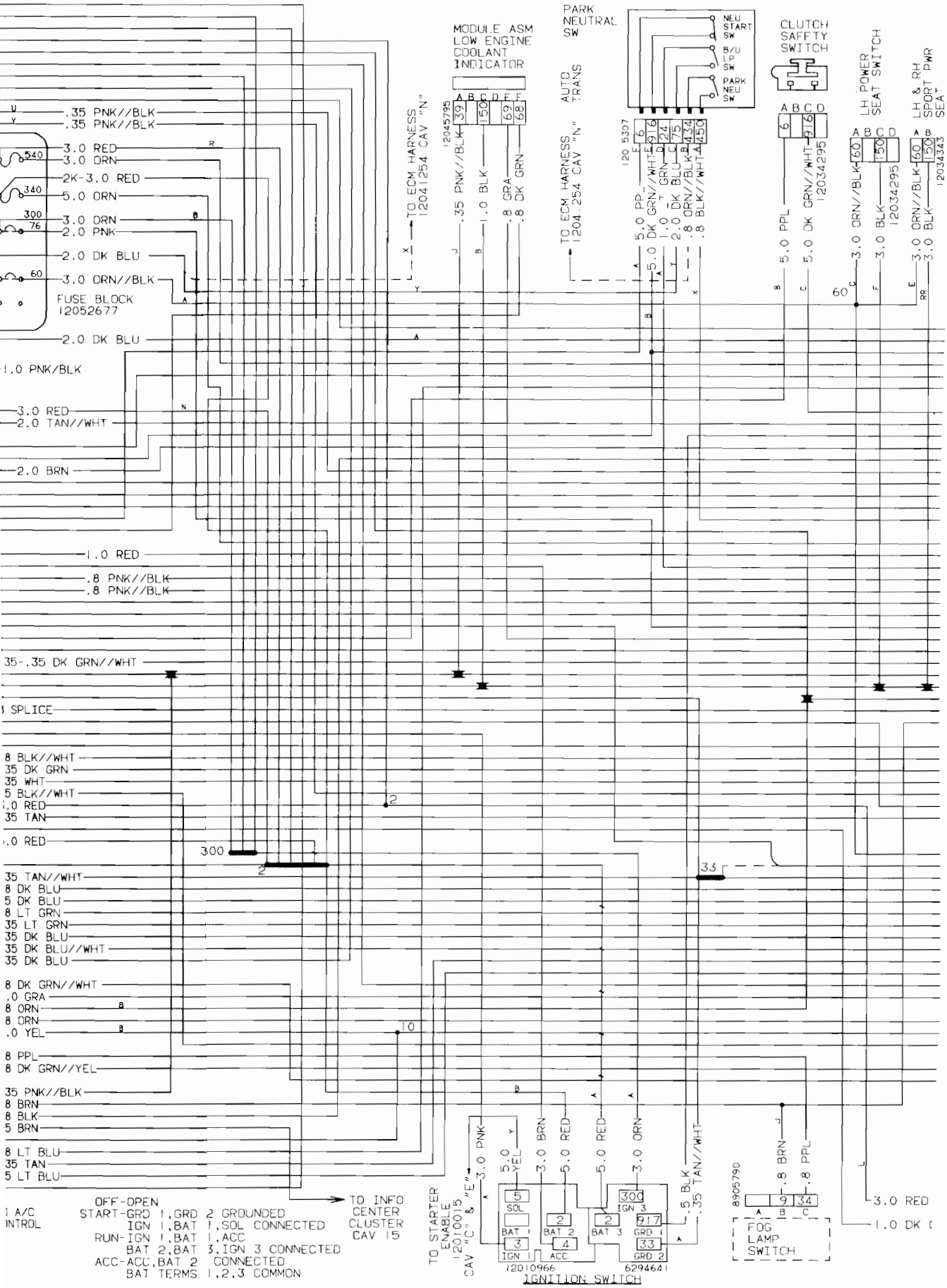
* Low-Energy Circuit


RH SIDE MARKER LAMP
6294015
9
15
8917280
RH PARK, DIR SIG LP
15
9
150
.8 DK BLU
.8 BRN
.8 BLK
.8 BRN
.8 DK BLU
HI-LO HD LP
12015793
150
11
12
1.0 BLK
1.0 LT GRN
1.0 TAN
RH HEAD LAMP ASSEMBLY
961
962
951
2.0 DK GRN//WHT
2.0 WHT//BLK
2.0 RED
12034351
RH FOG LP
34
150
.8 PPL
.8 BLK
12020599
3.0 BLK
RH HORN
8911288
150
29
2.0 BLK
2.0 BLK/GRN
A/C SENSOR
12015792
154
904
.8 BLK
.8 YEL
29C
LH HORN
8911288
150
29
2.0 BLK
2.0 BLK/GRN
12020941
2.0 DK GRN
2.0 BLK
LH FOG LP
150
34
.8 BLK
.8 PPL
12020599
2.0 BLK/GRN
12034351
953
952
950
2.0 DK GRN
2.0 NAT WHT
2.0 GRA
LH HEAD LAMP ASSEMBLY
150
11
12
1.0 BLK
1.0 LT GRN
1.0 TAN
12015793
HI LO HD LP
.8 BRN
.8 LT BLU
150
14
9
.8 BLK
.8 LT BLU
.8 BRN
8917280
LH PARK, DIR SIG LP
LH SIDE MARKER LAMP

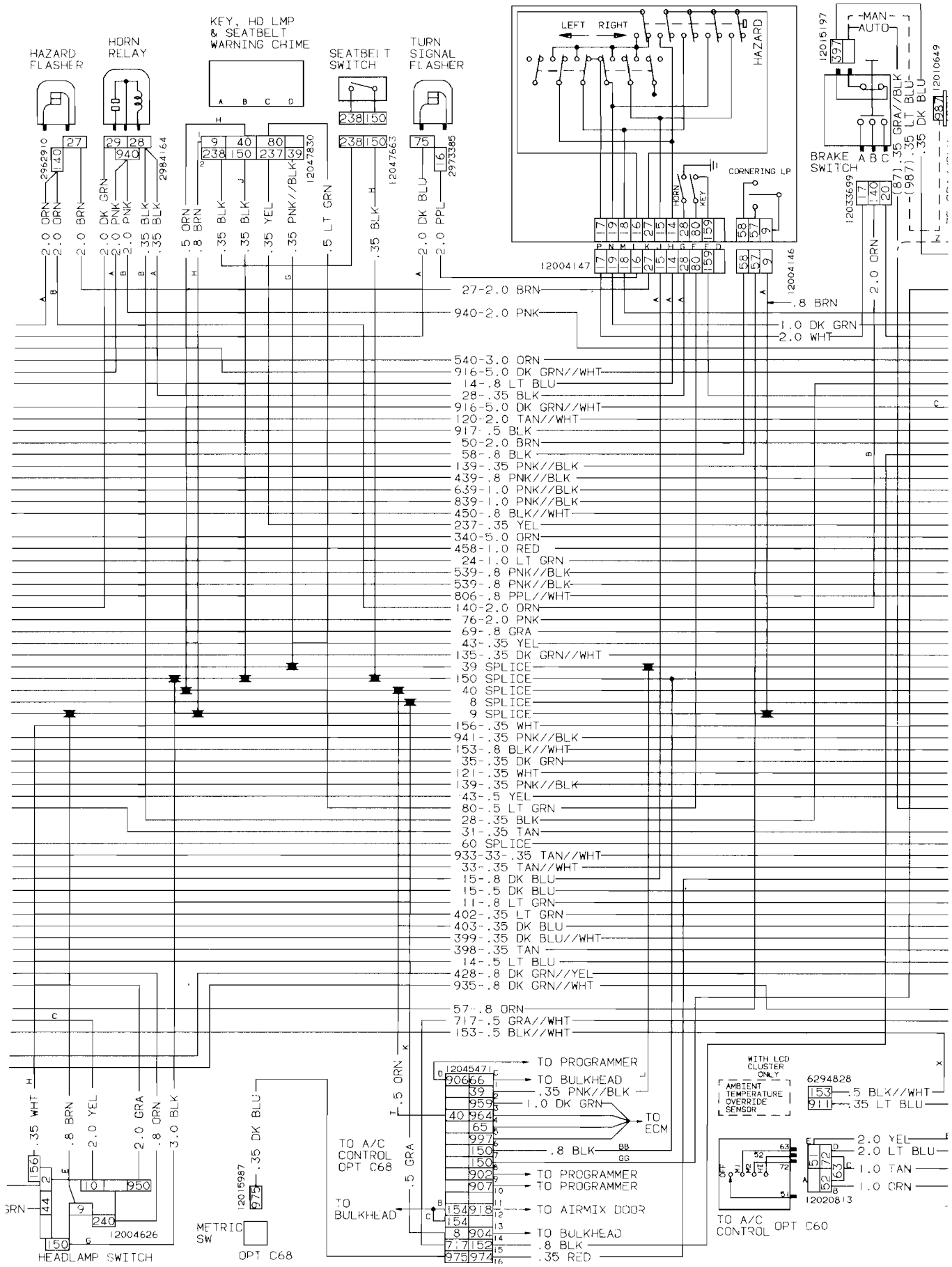

RH CORNERING LAMP
8917822
.8 BLK
.8 BLK
RH U/HOOD LP
.5 ORN
.5 BLK
12015454
TO BATTERY CABLE
12010996
3.0 RED
12010973
HEAVY DUTY COOLING FAN OPT V08
TO ELECTRIC COOLING FAN
12033769
3.0 BLK//RED
3.0 BLK
12020014
2.0 WHT//BLK
2.0 DK GRN//WHT
RH HDLAMP RLY
2.0 BLK
2.0 YEL
2.0 RED
12020013
LH HDLAMP RLY
2.0 NAT WHT
2.0 DK GRN
150 GROUND
.8 RED THERMO HW
JUNCT-BLOC
2.0 BLK
3.0 BLK
LH GROUND
12020266
2.0 YEL
2.0 GRA
1.0 BLK
2.0 RED
LH U/HOOD LP
CANISTER PURGE SOLENOID
ELECTRIC FAN RELAY
.8 BRN
.8 LT BLU
.8 ORN
6294015
LH CORNERING LAMP


LOW COOLANT SENSOR
2977376
.8 DK GRN
TO W/S WIPER MOTOR
12020556
92
991
.8 PPL
.8 GRA
12034344
92 A
991 B
TO E HARN
TO W/S WASHER PUMP
8917261
94
150
.8 PNK
.8 BLK
12010973
94 B
150 A
12010015
.8 DK BLU
ELECTRIC FAN RELAY
OPT V08
3.0 RED THERMO HW
8.0 RED
1.0 RED THERMO HW
3.0 RED
.8 DK BLU
.8 BRN
ALT
12045896
ISOLATION RELAY
.8 BLK
.5 DK GRN//WHT
2.0 YEL
.5 ORN
.5 ORN
.8 DK BLU
1.0 LT GRN
2.0 BLK/GRN
.8 DK GRN
1.0 TAN
1.0 LT GRN
3.0 RED
.8 DK BLU
.8 DK GRN//WHT
3.0 BLK//RED
12010015
.8 ORN
2.0 GRA
.8 PPL
.8 PPL
.8 DK GRN//YEL
.8 PNK//BLK
1.0 TAN
.8 BRN
.8 BRN
.8 YEL
.8 LT BLU
12015509
.5 TAN/
BRA (GI
12020646
.5 DK BLU
.5 TAN
.8 BLK
.5 LT BLU //BLK
.5 LT GRN
403 398 150 399 402
CRUISE CONT. SERVO
OPT K34

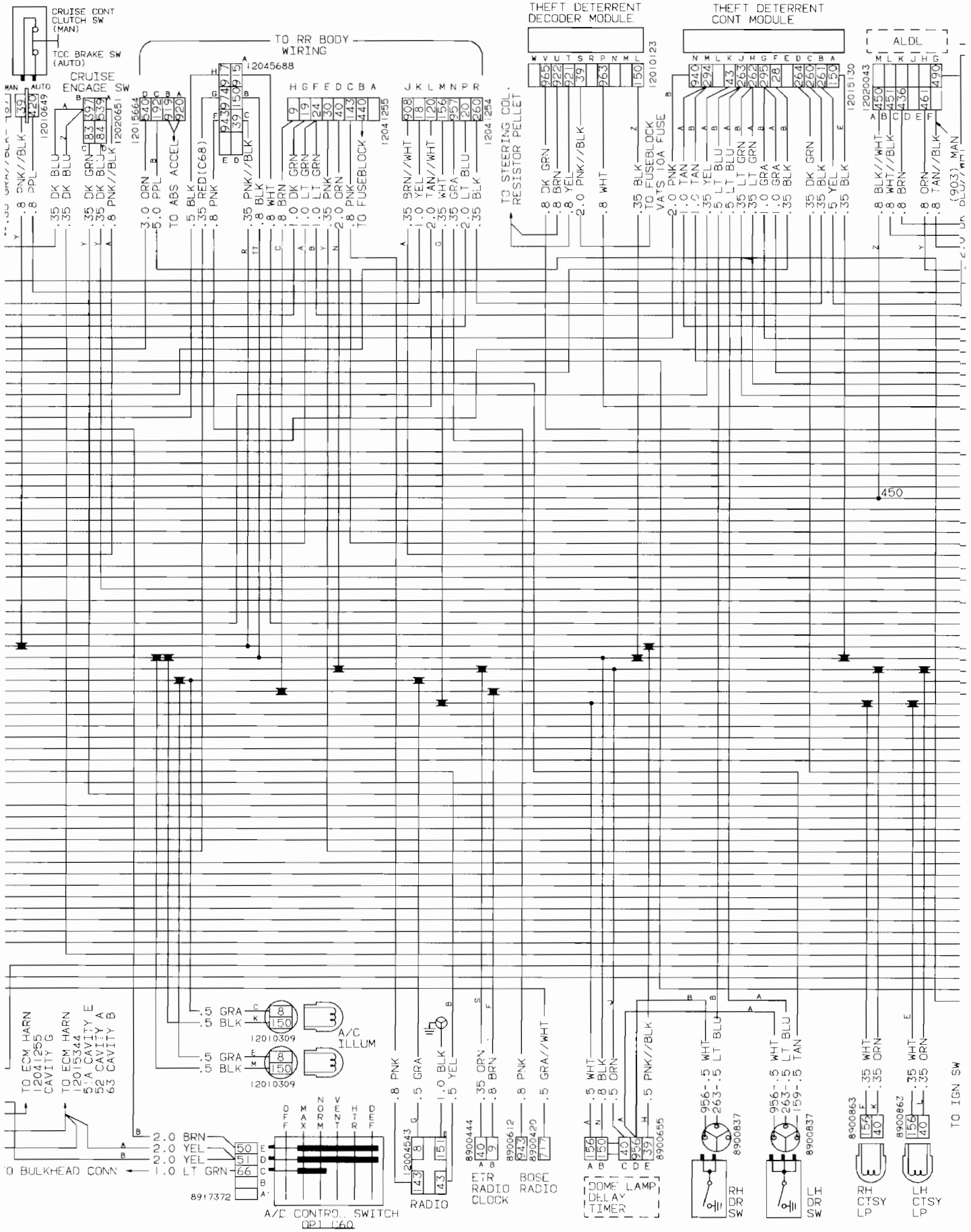

LOW TIRE PRESSURE
HI
LO
DELAY
OFF
MIST
WASH
W/S WIPER SWITCH
TO RR BODY WIRING 12041255 CAVITY "B"
2.0 ORN//BLK
3.0 PNK
3.0 RED
3.0 ORN
3.0 RED
3.0 RED
2.0 ORN
.8 ORN
3.0 ORN
.35 DK BLU
2.0 ORN
BRAKE
A/C
LCD
VATS
CTSY/CLK
TAIL
STOP/HAZ
RDO
WIPER
C/FAN
INJ 1
INJ 2
ECM ENG
INST
CLSTR
GAUGES
TURN/BU
CRUISE
FUEL PUMP
TO INFORMATION CENTER CLUSTER CAV "7"
TO ECM HARN 12015344 CAV "E" OPT C68 ONLY
TO THEFT DET S DECODER-CAV
OPT C60 ONLY
FUSE BLOCK 12065405
3.0 PPL (AUTO)
(6) 3.0 PPL (MAN)
CINJ
(2F) 3.0 RED
THEFT
(916A) 5.0 DK GRN//WHT
HATCH AUTO
2.0 PNK
.8 PPL//WHT
.35 TAN//WHT
.8 PNK//BLK
.8 TAN//WHT
3.0 PNK
.8 BRN
.5 LT BLU
5.0 PPL
1.0 PPL
1.0 GRA
1.0 LT GRN
.8 DK GRN
2.0 DK GRN
.8 YEL(C68)
.8 BLK(C68)
PARK BRAKE ALARM SWITCH
WATER TEMP SWITCH
TO "THEFT" DETERRENT DECODER MODULE 12010123 CAV "T" & "U"
DIMMER SW (COL MTD)
2.0 YEL
1.0 TAN
1.0 LT GRN
STEERING COLUMN RESISTOR PELLET

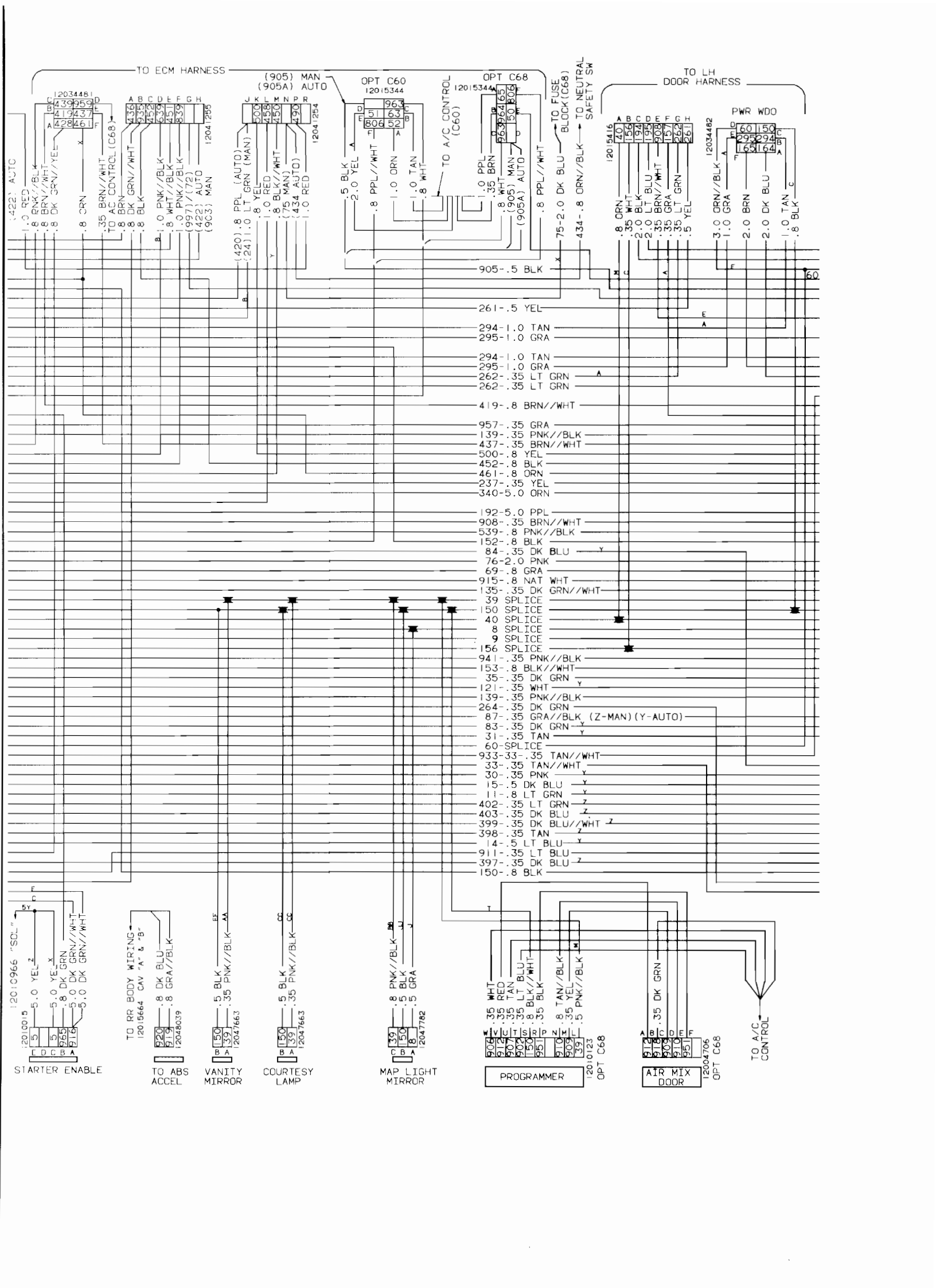

MODULE ASM LOW ENGINE COOLANT INDICATOR
PARK NEUTRAL SW
AUTO TRANS
CLUTCH SAFETY SWITCH
LH POWER SEAT SWITCH
LH & RH SPORT PWR SEAT
TO ECM HARNESS 12041254 CAV "N"
FUSE BLOCK 12052677
.35 PNK//BLK
3.0 RED
3.0 ORN
2K-3.0 RED
5.0 ORN
2.0 PNK
2.0 DK BLU
3.0 ORN//BLK
1.0 PNK/BLK
2.0 TAN//WHT
2.0 BRN
1.0 RED
.8 PNK//BLK
.35 DK GRN//WHT
SPLICE
.35 TAN//WHT
.35 DK BLU
.8 LT GRN
.35 LT GRN
.35 DK BLU//WHT
.8 DK GRN//WHT
.0 GRA
.0 YEL
.8 PPL
.8 DK GRN//YEL
.35 PNK//BLK
.8 BRN
.8 BLK
.5 BRN
.8 LT BLU
.35 TAN
.5 LT BLU
5.0 PPL
5.0 DK GRN//WHT 12034295
3.0 ORN//BLK
3.0 BLK 12034295
3.0 ORN//BLK
3.0 BLK 12034343
.35 PNK//BLK 12045795
1.0 BLK
.8 GRA
.8 DK GRN
5.0 PP DK GRN//WHT
1.0 GRN
2.0 DK BLU
.8 ORN//BLK
.8 BLK//WHT
120 5397
.5 BLK
.35 TAN//WHT
.8 BRN
.8 PPL
3.0 RED
1.0 DK (
3.0 PNK
5.0 YEL
3.0 BRN
5.0 RED
5.0 RED
3.0 ORN
TO STARTER ENABLE 12010015 CAV "C" & "E"
TO INFO CENTER CLUSTER CAV 15
OFF-OPEN
START-GRD 1,GRD 2 GROUNDED
IGN 1,BAT 1,SOL CONNECTED
RUN-IGN 1,BAT 1,ACC
BAT 2,BAT 3,IGN 3 CONNECTED
ACC-ACC,BAT 2 CONNECTED
BAT TERMS 1,2,3 COMMON
12010966
6294641
IGNITION SWITCH
8905790
FOG LAMP SWITCH
A/C
NTROL
IGTN SW

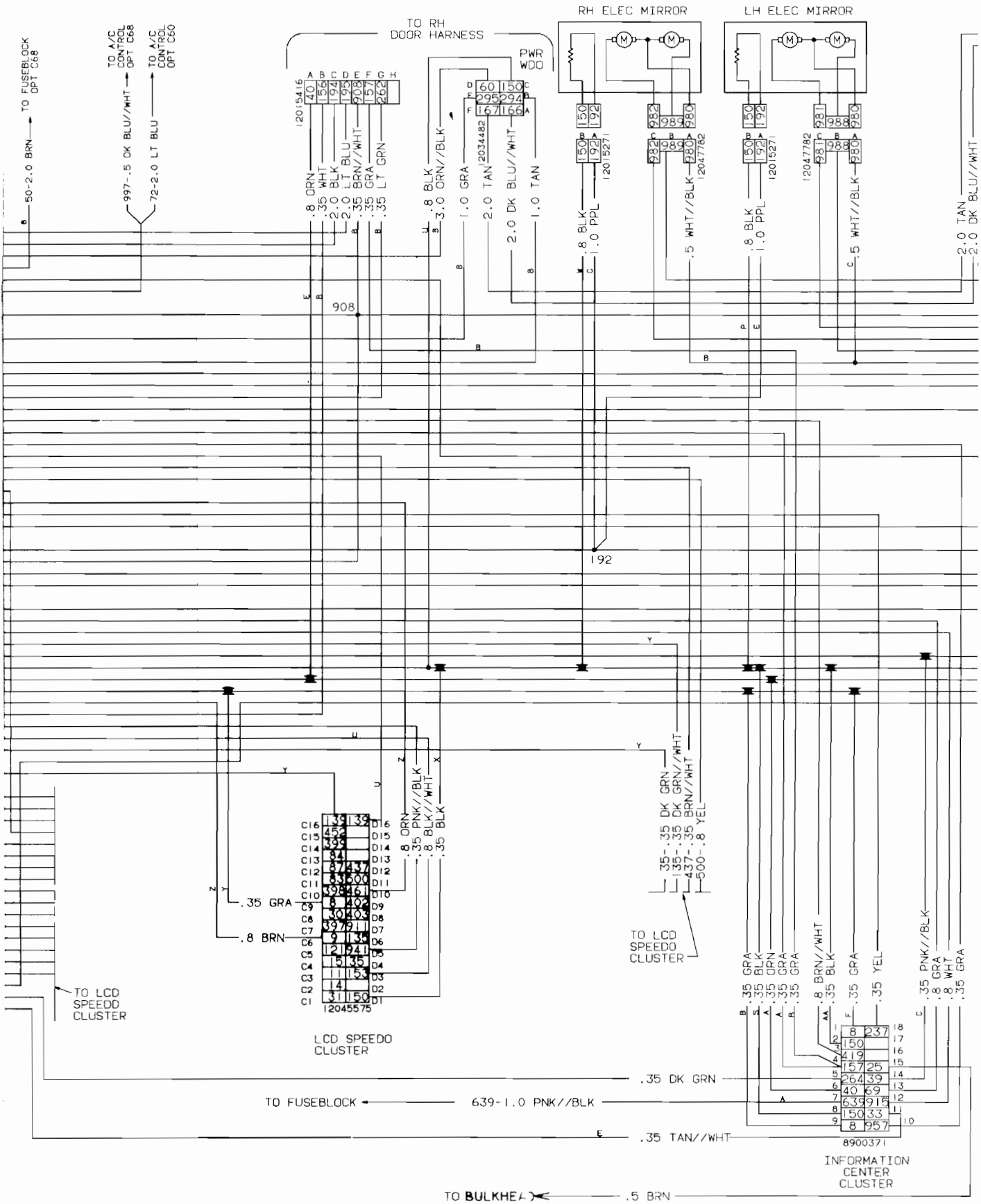
CORVETTE 1

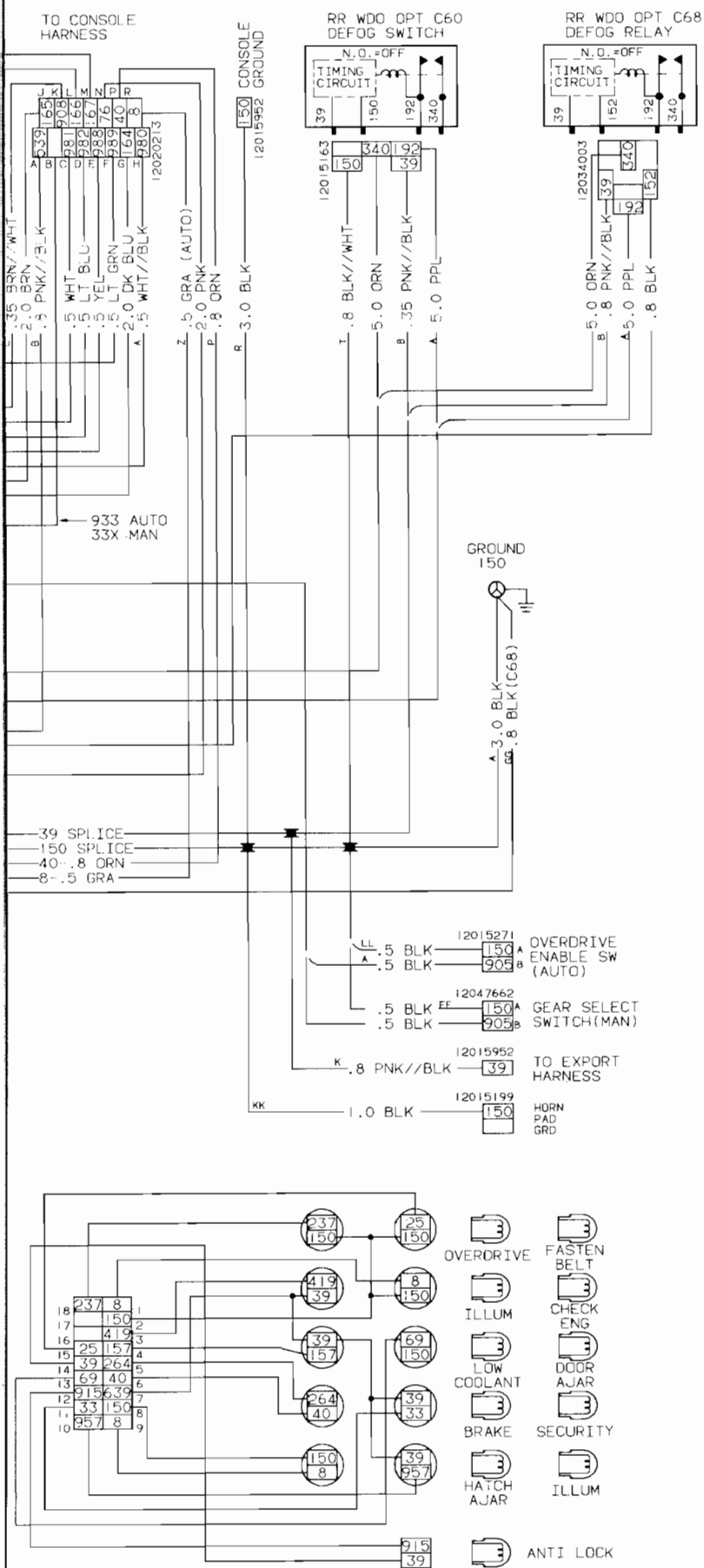

HAZARD FLASHER
HORN RELAY
KEY, HD LMP & SEATBELT WARNING CHIME
SEATBELT SWITCH
TURN SIGNAL FLASHER
LEFT
RIGHT
HAZARD
CORNERING LP
HORN
KEY
MAN
AUTO
BRAKE SWITCH
12004147
12004146
27-2.0 BRN
940-2.0 PNK
.8 BRN
1.0 DK GRN
2.0 WHT
2.0 ORN
540-3.0 ORN
916-5.0 DK GRN//WHT
14-.8 LT BLU
28-.35 BLK
916-5.0 DK GRN//WHT
120-2.0 TAN//WHT
917-.5 BLK
50-2.0 BRN
58-.8 BLK
139-.35 PNK//BLK
439-.8 PNK//BLK
639-1.0 PNK//BLK
839-1.0 PNK//BLK
450-.8 BLK//WHT
237-.35 YEL
340-5.0 ORN
458-1.0 RED
24-1.0 LT GRN
539-.8 PNK//BLK
539-.8 PNK//BLK
806-.8 PPL//WHT
140-2.0 ORN
76-2.0 PNK
69-.8 GRA
43-.35 YEL
135-.35 DK GRN//WHT
39 SPLICE
150 SPLICE
40 SPLICE
8 SPLICE
9 SPLICE
156-.35 WHT
941-.35 PNK//BLK
153-.8 BLK//WHT
35-.35 DK GRN
121-.35 WHT
139-.35 PNK//BLK
43-.5 YEL
80-.5 LT GRN
28-.35 BLK
31-.35 TAN
60 SPLICE
933-33-.35 TAN//WHT
33-.35 TAN//WHT
15-.8 DK BLU
15-.5 DK BLU
11-.8 LT GRN
402-.35 LT GRN
403-.35 DK BLU
399-.35 DK BLU//WHT
398-.35 TAN
14-.5 LT BLU
428-.8 DK GRN//YEL
935-.8 DK GRN//WHT
57-.8 ORN
717-.5 GRA//WHT
153-.5 BLK//WHT
TO PROGRAMMER
TO BULKHEAD
.35 PNK//BLK
1.0 DK GRN
TO ECM
.8 BLK
TO PROGRAMMER
TO PROGRAMMER
TO AIRMIX DOOR
TO BULKHEAD
.8 BLK
.35 RED
.5 ORN
.5 GRA
TO A/C CONTROL OPT C68
WITH LCD CLUSTER ONLY
AMBIENT TEMPERATURE OVERRIDE SENSOR
6294828
.5 BLK//WHT
.35 LT BLU
2.0 YEL
2.0 LT BLU
1.0 TAN
1.0 ORN
12020813
TO A/C CONTROL OPT C60
.35 WHT
.8 BRN
2.0 YEL
2.0 GRA
.8 ORN
3.0 BLK
.35 DK BLU
12015987
METRIC SW
OPT C68
12004626
HEADLAMP SWITCH

CORVETTE 1A

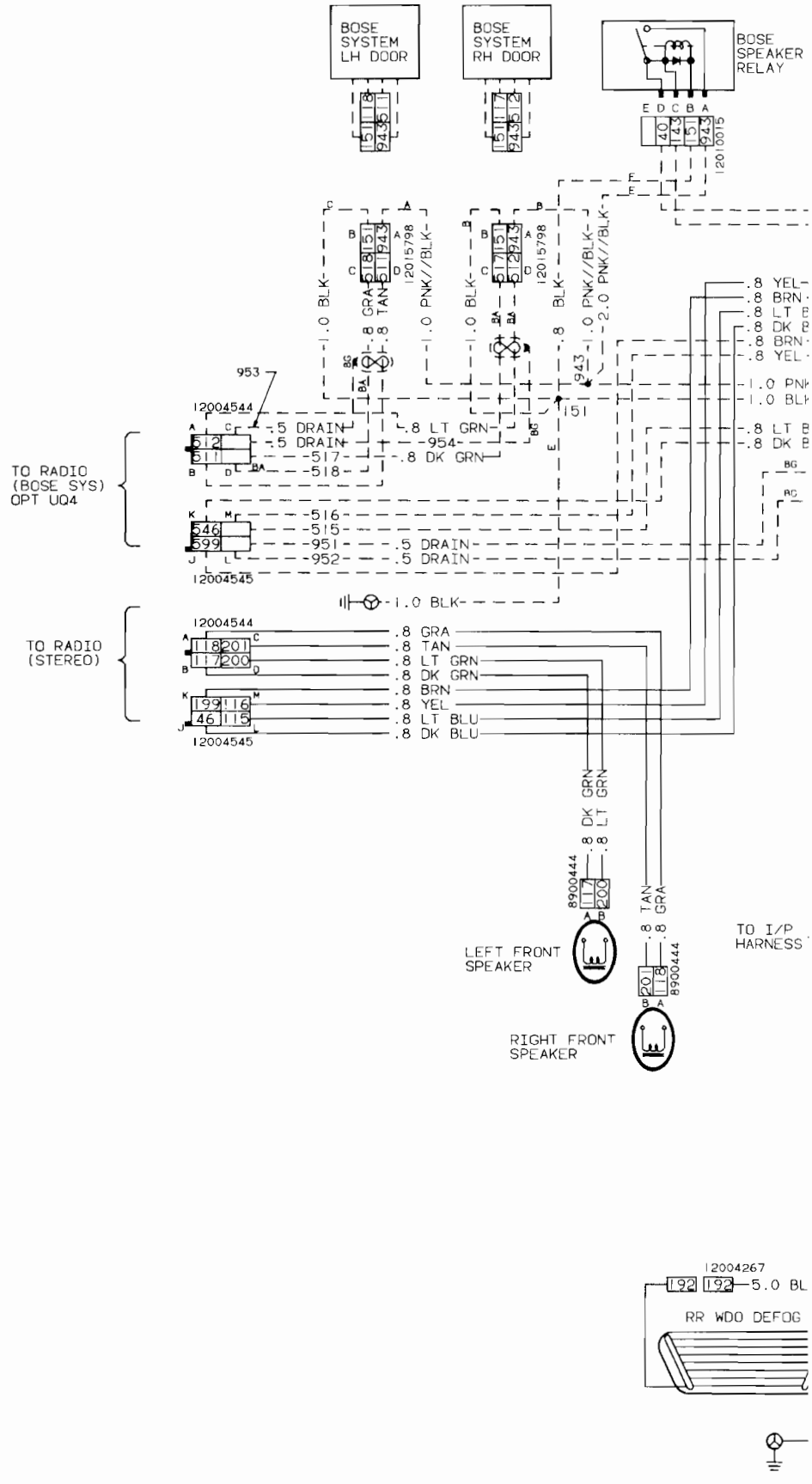

CRUISE CONT CLUTCH SW (MAN)
TCC BRAKE SW (AUTO)
CRUISE ENGAGE SW
TO RR BODY WIRING
TO ABS ACCEL
THEFT DETERRENT DECODER MODULE
THEFT DETERRENT CONT MODULE
ALDL
TO STEERING COL. RESISTOR PELLET
TO FUSEBLOCK
TO FUSEBLOCK VATS 10A FUSE
450
TO ECM HARN 12041255 CAVITY G
TO ECM HARN 12015344 51 CAVITY E 52 CAVITY A 63 CAVITY B
A/C ILLUM
TO BULKHEAD CONN
A/C CONTROL SWITCH OPT C60
RADIO
ETR RADIO CLOCK
BOSE RADIO
DOME LAMP DELAY TIMER
RH DR SW
LH DR SW
RH CTSY LP
LH CTSY LP
TO IGN SW

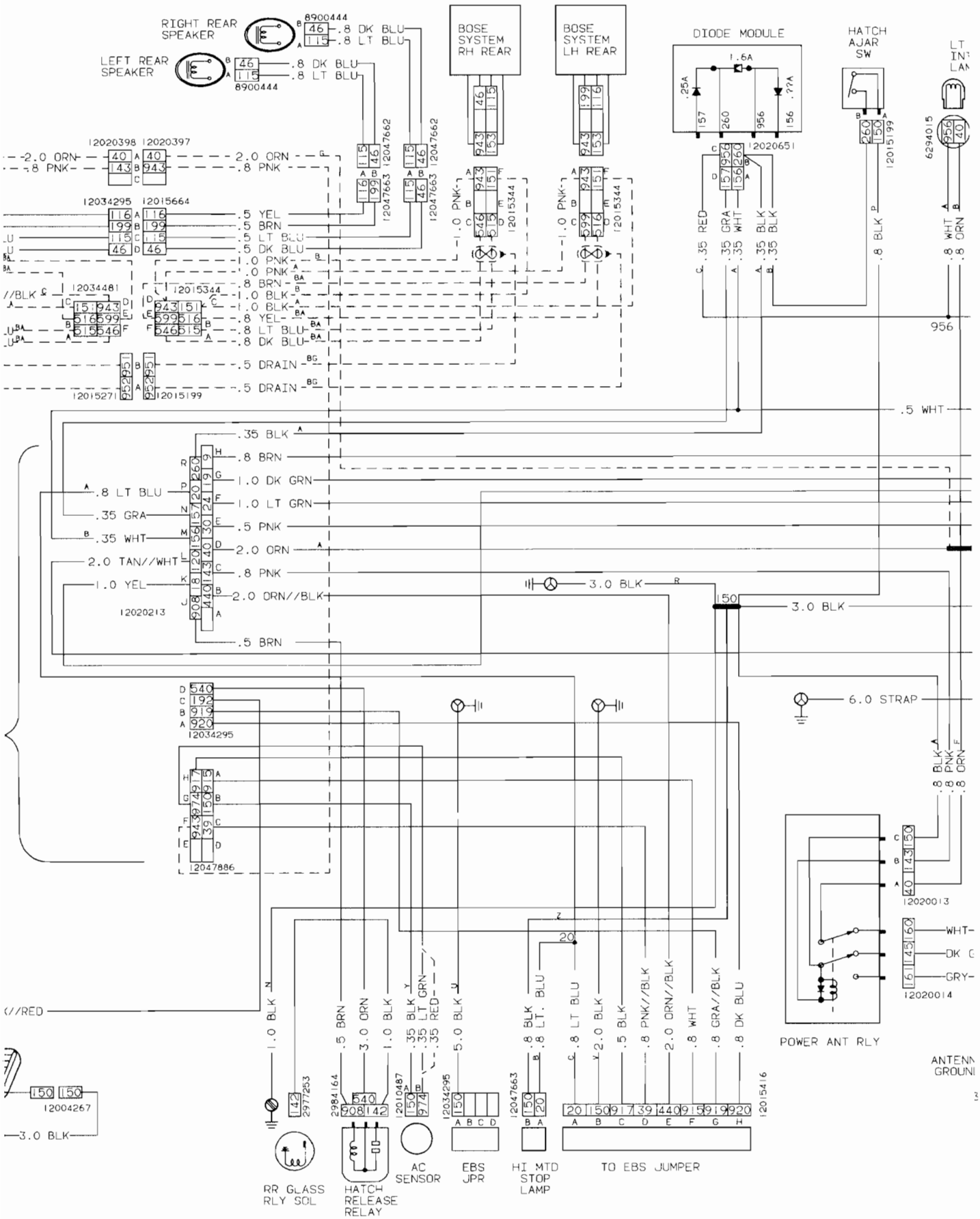

TO ECM HARNESS
(905) MAN
(905A) AUTO
OPT C60
12015344
OPT C68
12015344
TO A/C CONTROL (C60)
TO FUSE BLOCK (C68)
TO NEUTRAL SAFETY SW
TO LH DOOR HARNESS
PWR WDO
12034482
12015416
12034481
12041255
12041254
905-.5 BLK
261-.5 YEL
294-1.0 TAN
295-1.0 GRA
262-.35 LT GRN
419-.8 BRN//WHT
957-.35 GRA
139-.35 PNK//BLK
437-.35 BRN//WHT
500-.8 YEL
452-.8 BLK
461-.8 ORN
237-.35 YEL
340-5.0 ORN
192-5.0 PPL
908-.35 BRN//WHT
539-.8 PNK//BLK
152-.8 BLK
84-.35 DK BLU
76-2.0 PNK
69-.8 GRA
915-.8 NAT WHT
135-.35 DK GRN//WHT
39 SPLICE
150 SPLICE
40 SPLICE
8 SPLICE
9 SPLICE
156 SPLICE
941-.35 PNK//BLK
153-.8 BLK//WHT
35-.35 DK GRN
121-.35 WHT
139-.35 PNK//BLK
264-.35 DK GRN
87-.35 GRA//BLK (Z-MAN)(Y-AUTO)
83-.35 DK GRN
31-.35 TAN
60-SPLICE
933-33-.35 TAN//WHT
33-.35 TAN//WHT
30-.35 PNK
15-.5 DK BLU
11-.8 LT GRN
402-.35 LT GRN
403-.35 DK BLU
399-.35 DK BLU//WHT
398-.35 TAN
14-.5 LT BLU
911-.35 LT BLU
397-.35 DK BLU
150-.8 BLK
12010966 "SCL"
12010015
12015664 CAV "A" & "B"
12048039
12047663
12047782
12010123
12004706
STARTER ENABLE
TO ABS ACCEL
VANITY MIRROR
COURTESY LAMP
MAP LIGHT MIRROR
PROGRAMMER
OPT C68
AIR MIX DOOR
OPT C68
TO A/C CONTROL

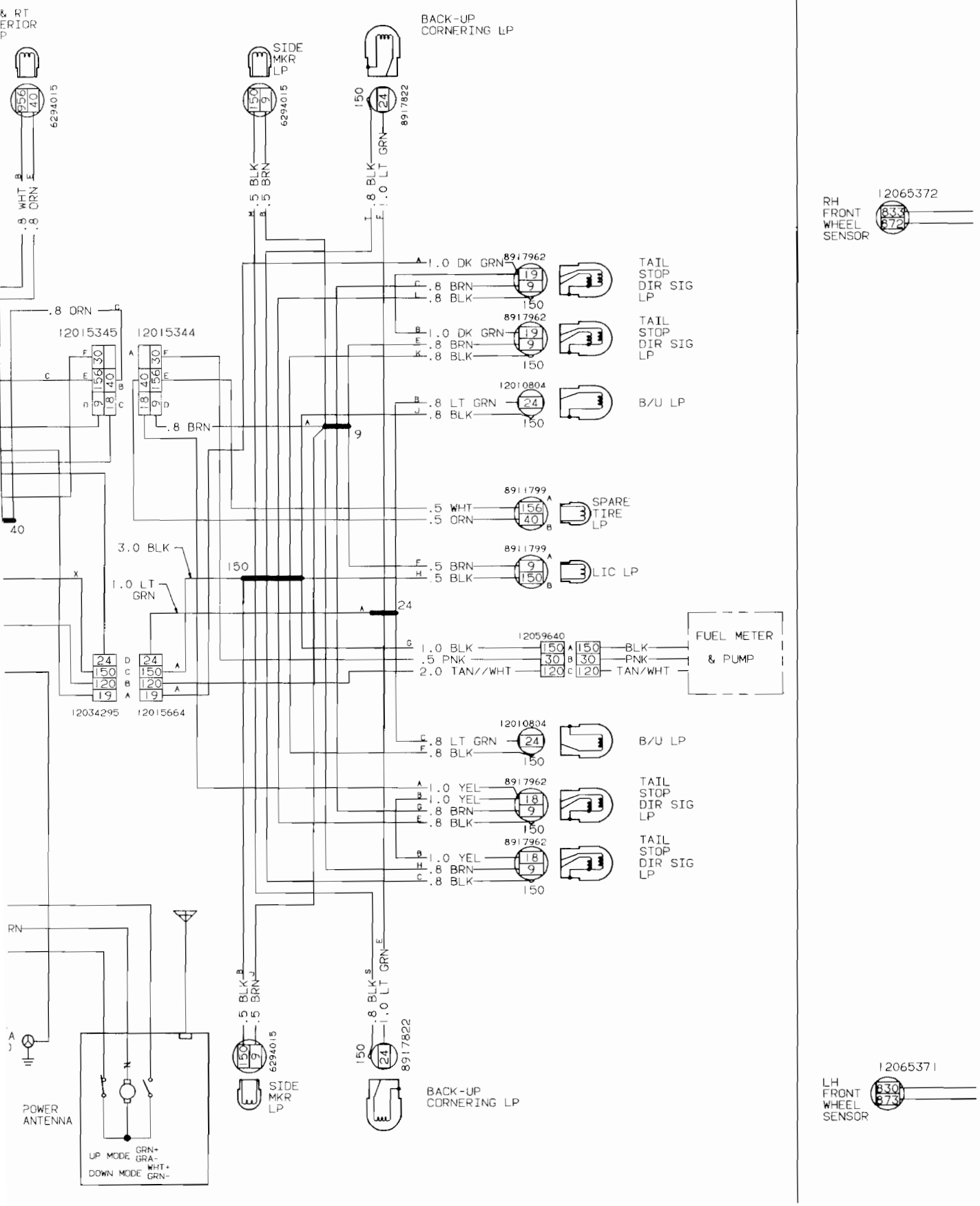

TO FUSEBLOCK OPT C68
50-2.0 BRN
TO A/C CONTROL OPT C68
997-.5 DK BLU//WHT
TO A/C CONTROL OPT C60
72-2.0 LT BLU
TO RH DOOR HARNESS
12015416
.8 ORN
.35 WHT
2.0 BLK
2.0 LT BLU
.35 BRN//WHT
.35 GRA
.35 LT GRN
PWR WDO
.8 BLK
3.0 ORN//BLK
1.0 GRA
2.0 TAN
2.0 DK BLU//WHT
1.0 TAN
12034482
RH ELEC MIRROR
LH ELEC MIRROR
.8 BLK
1.0 PPL
12015271
.5 WHT//BLK
12047782
908
192
.8 ORN
.35 PNK//BLK
.8 BLK//WHT
.35 BLK
.35 GRA
.8 BRN
12045575
LCD SPEEDO CLUSTER
TO LCD SPEEDO CLUSTER
.35 DK GRN
.35 DK GRN//WHT
.35 BRN//WHT
.8 YEL
.35 GRA
.35 BLK
.35 ORN
.35 BRN//WHT
.35 YEL
.35 PNK//BLK
.8 GRA
.8 WHT
.35 TAN//WHT
639-1.0 PNK//BLK
TO FUSEBLOCK
8900371
INFORMATION CENTER CLUSTER
.5 BRN
TO BULKHEAD
2.0 TAN
2.0 DK BLU//WHT

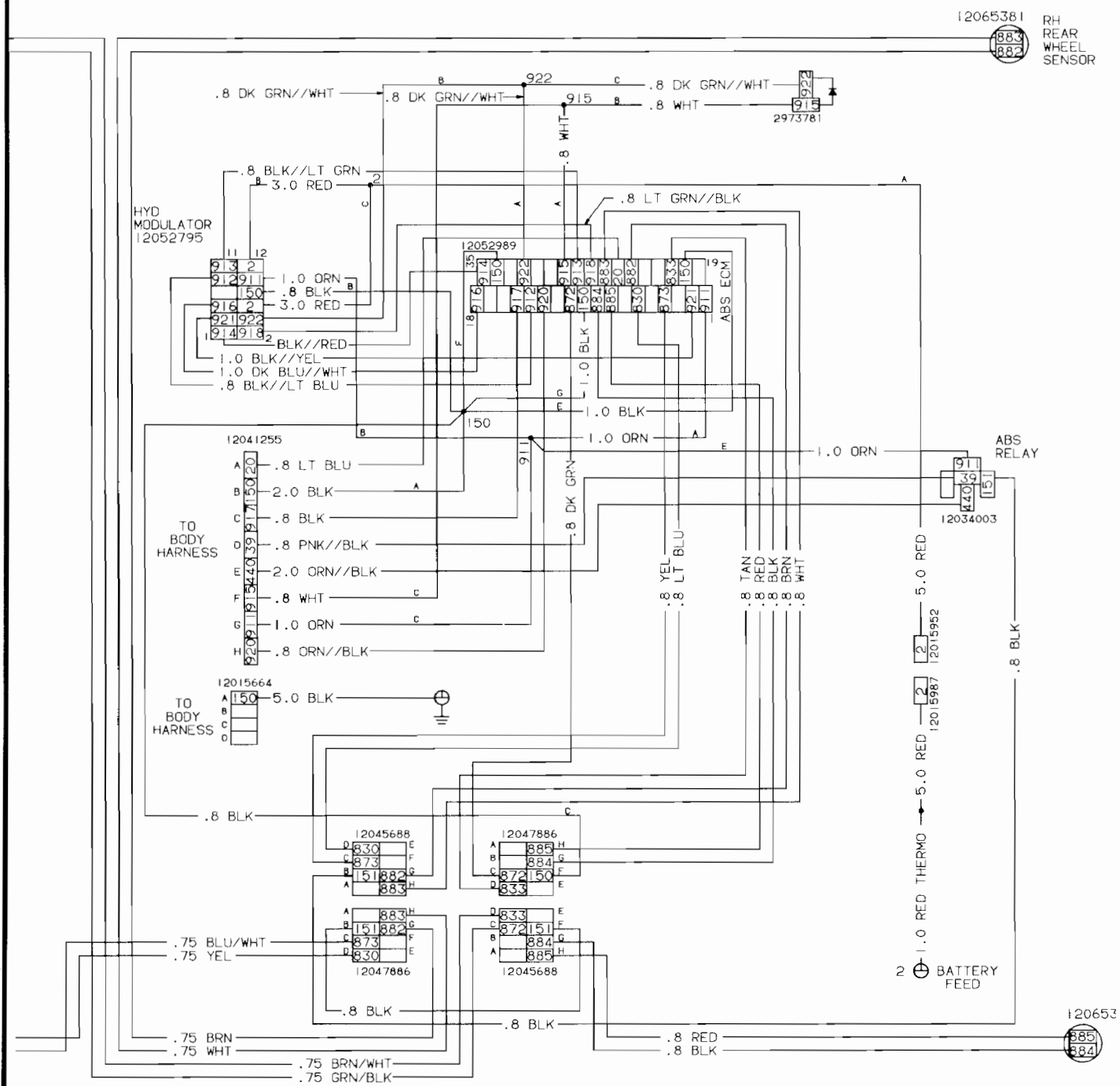

TO CONSOLE HARNESS
CONSOLE GROUND
150
12015952
RR WDO OPT C60 DEFOG SWITCH
N.O.=OFF
TIMING CIRCUIT
RR WDO OPT C68 DEFOG RELAY
12015163
12034003
933 AUTO
33X MAN
GROUND
150
39 SPLICE
150 SPLICE
40 .8 ORN
8 .5 GRA
12015271
OVERDRIVE ENABLE SW (AUTO)
12047662
GEAR SELECT SWITCH(MAN)
12015952
TO EXPORT HARNESS
12015199
HORN PAD GRD

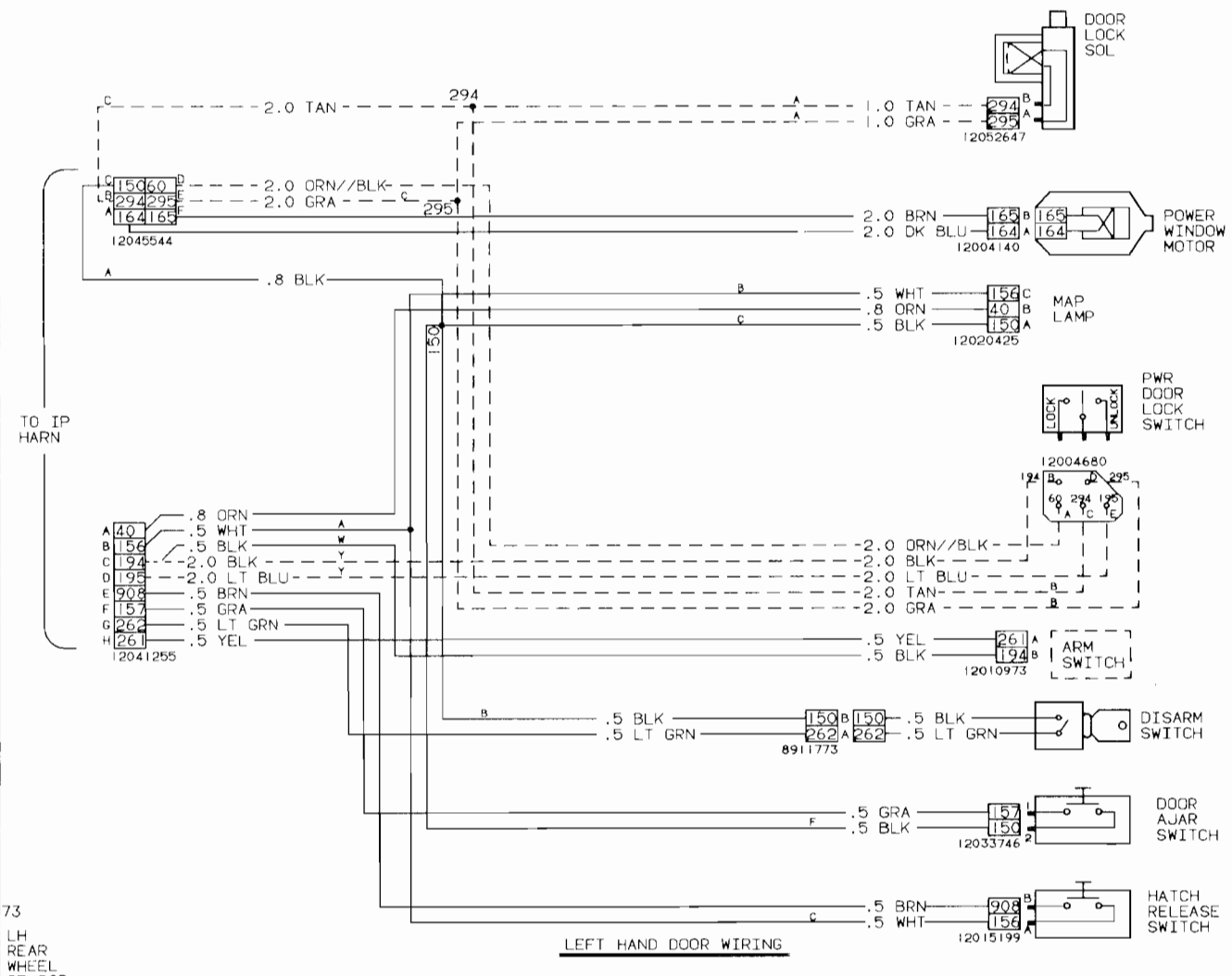
OVERDRIVE
FASTEN BELT
ILLUM
CHECK ENG
LOW COOLANT
DOOR AJAR
BRAKE
SECURITY
HATCH AJAR
ILLUM
ANTI LOCK

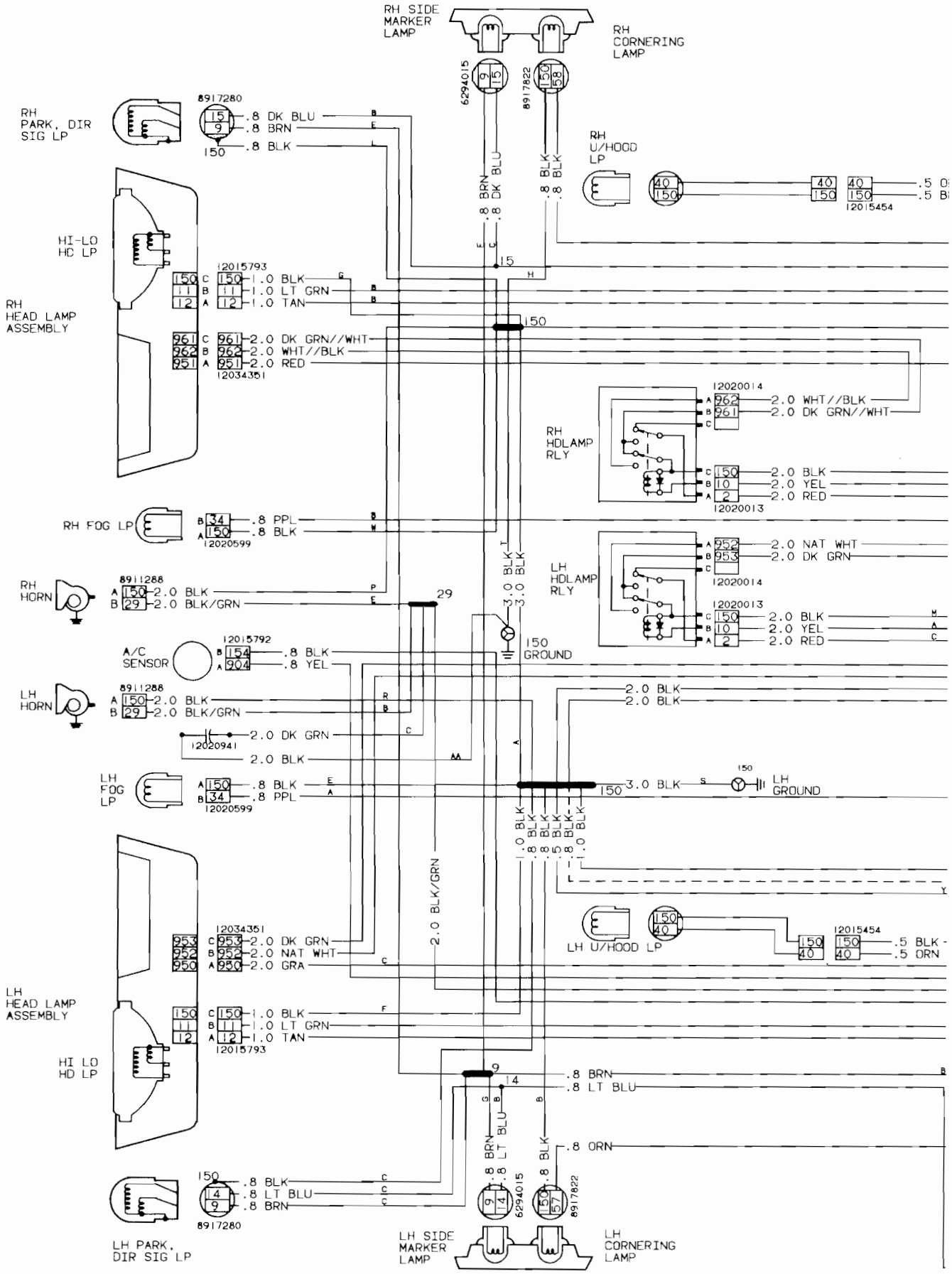

BOSE SYSTEM LH DOOR
BOSE SYSTEM RH DOOR
BOSE SPEAKER RELAY
12010015
12015798
953
151
943
12004544
12004545
.5 DRAIN
.8 LT GRN
.5 DRAIN
954
517
.8 DK GRN
518
516
515
951
.5 DRAIN
952
.5 DRAIN
1.0 BLK
TO RADIO (BOSE SYS) OPT UQ4
TO RADIO (STEREO)
.8 GRA
.8 TAN
.8 LT GRN
.8 DK GRN
.8 BRN
.8 YEL
.8 LT BLU
.8 DK BLU
8900444
LEFT FRONT SPEAKER
RIGHT FRONT SPEAKER
TO I/P HARNESS
12004267
5.0 BL
RR WDO DEFOG


RIGHT REAR SPEAKER
LEFT REAR SPEAKER
8900444
.8 DK BLU
.8 LT BLU
BOSE SYSTEM RH REAR
BOSE SYSTEM LH REAR
DIODE MODULE
1.6A
.25A
HATCH AJAR SW
12020398
12020397
12034295
12015664
12047662
12047663
12015344
12034481
12015199
12015527
12020651
12020213
12047886
12034295
12020013
12020014
12004267
6294015
.5 YEL
.5 BRN
.5 LT BLU
.5 DK BLU
1.0 PNK
.8 BRN
1.0 BLK
.8 YEL
.8 LT BLU
.8 DK BLU
.5 DRAIN
.5 WHT
.35 BLK
.8 BRN
1.0 DK GRN
1.0 LT GRN
.5 PNK
2.0 ORN
.8 PNK
2.0 ORN//BLK
.5 BRN
2.0 TAN//WHT
1.0 YEL
.35 GRA
.35 WHT
3.0 BLK
6.0 STRAP
956
150
.8 BLK
.8 PNK
.8 ORN
.8 WHT
.35 RED
.35 GRA
.35 WHT
.35 BLK
.8 BLK P
1.0 BLK
.5 BRN
3.0 ORN
1.0 BLK
.35 BLK
.35 LT GRN
.35 RED
5.0 BLK
.8 BLK
.8 LT. BLU
.8 LT BLU
2.0 BLK
.5 BLK
.8 PNK//BLK
2.0 ORN//BLK
.8 WHT
.8 GRA//BLK
.8 DK BLU
WHT-
DK
GRY-
POWER ANT RLY
ANTENN
GROUN
RR GLASS RLY SOL
HATCH RELEASE RELAY
AC SENSOR
EBS JPR
HI MTD STOP LAMP
TO EBS JUMPER

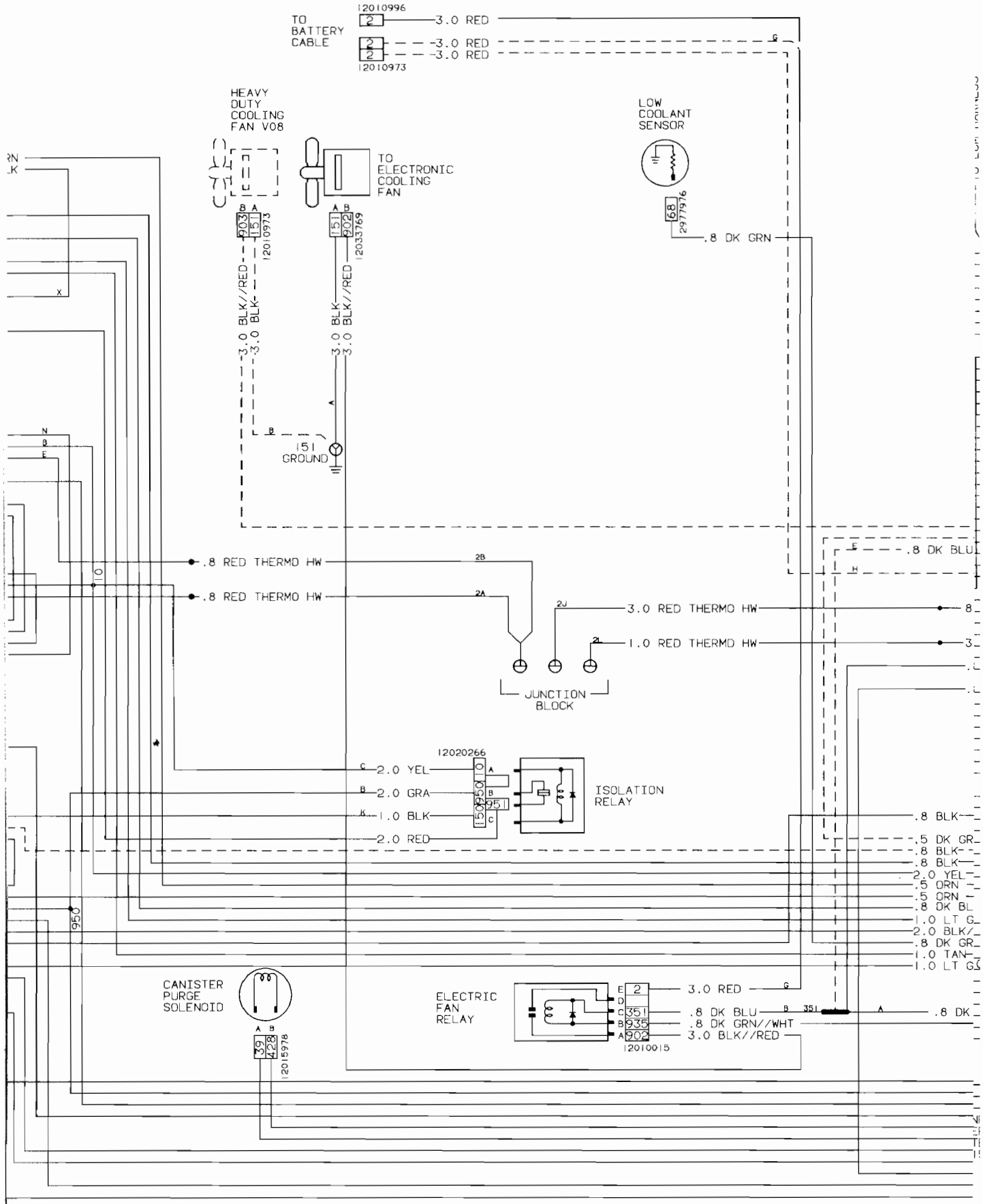

& RT
ERIOR
P
956
40
6294015
.8 WHT
.8 ORN
SIDE
MKR
LP
150
9
6294015
.5 BLK
.5 BRN
BACK-UP
CORNERING LP
150
24
8917822
.8 BLK
1.0 LT GRN
.8 ORN
12015345
12015344
30
156
40
18
9
.8 BRN
40
3.0 BLK
150
1.0 LT
GRN
24
150
120
19
12034295
12015664
1.0 DK GRN
8917962
19
.8 BRN
.8 BLK
TAIL
STOP
DIR SIG
LP
.8 LT GRN
12010804
B/U LP
8911799
.5 WHT
.5 ORN
SPARE
TIRE
LP
.5 BRN
.5 BLK
LIC LP
12059640
1.0 BLK
.5 PNK
2.0 TAN//WHT
BLK
PNK
TAN/WHT
FUEL METER
& PUMP
1.0 YEL
18
RH
FRONT
WHEEL
SENSOR
12065372
833
872
LH
FRONT
WHEEL
SENSOR
12065371
830
873
RN
POWER
ANTENNA
UP MODE GRN+
GRA-
DOWN MODE WHT+
GRN-

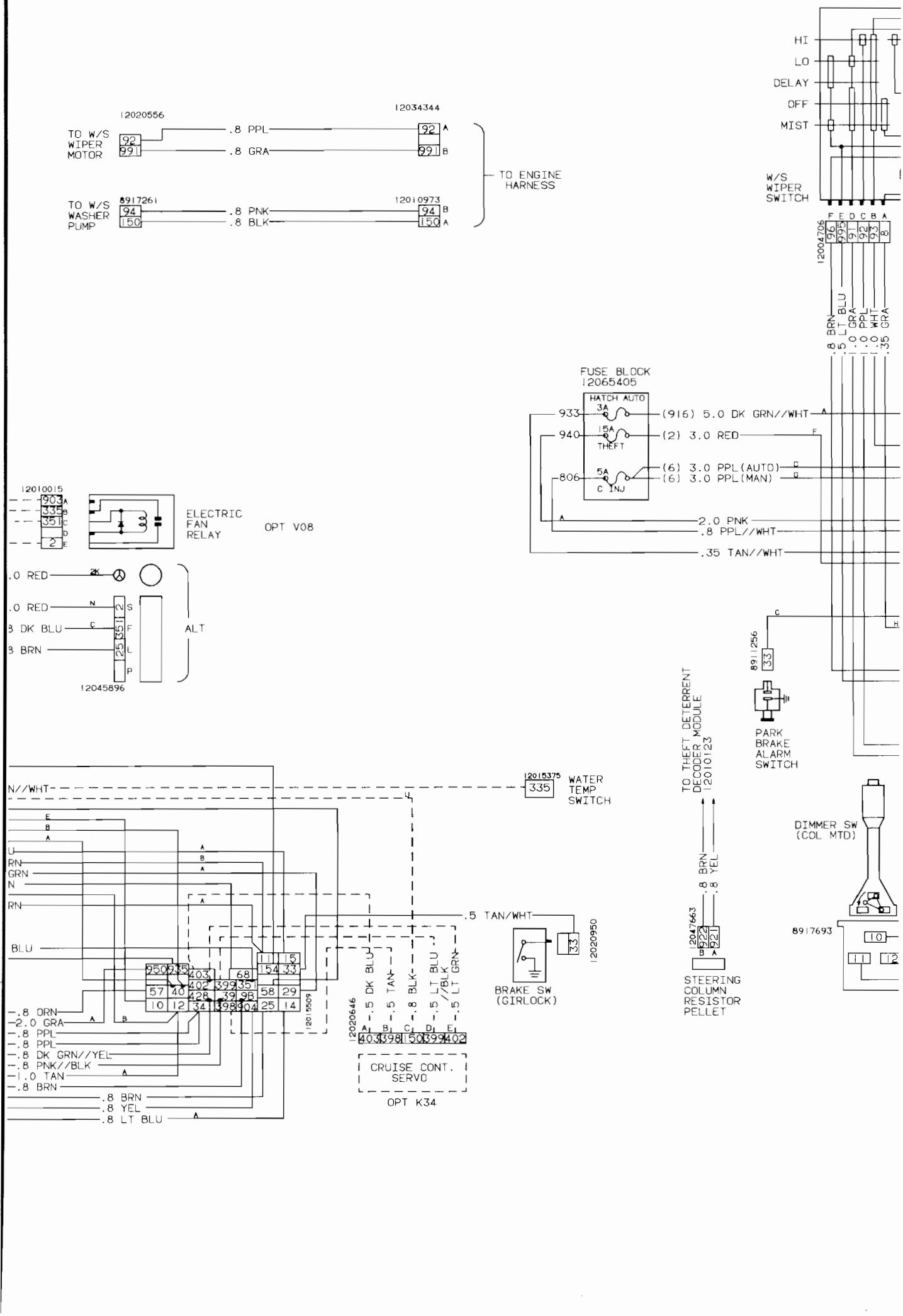

12065381
RH REAR WHEEL SENSOR
.8 DK GRN//WHT
922
.8 DK GRN//WHT
915
.8 WHT
2973781
.8 BLK//LT GRN
3.0 RED
HYD MODULATOR 12052795
.8 LT GRN//BLK
12052989
ABS ECM
1.0 ORN
.8 BLK
3.0 RED
BLK//RED
1.0 BLK//YEL
1.0 DK BLU//WHT
.8 BLK//LT BLU
1.0 BLK
1.0 ORN
ABS RELAY
12034003
12041255
TO BODY HARNESS
.8 LT BLU
2.0 BLK
.8 BLK
.8 PNK//BLK
2.0 ORN//BLK
.8 WHT
1.0 ORN
.8 ORN//BLK
.8 DK GRN
.8 YEL
.8 LT BLU
.8 TAN
.8 RED
.8 BLK
.8 BRN
.8 WHT
5.0 RED
12015952
12015987
5.0 RED
1.0 RED THERMO
2 BATTERY FEED
12015664
TO BODY HARNESS
5.0 BLK
.8 BLK
12045688
12047886
12047886
12045688
.75 BLU/WHT
.75 YEL
.8 BLK
.8 BLK
.75 BRN
.75 WHT
.75 BRN/WHT
.75 GRN/BLK
.8 RED
.8 BLK
120653

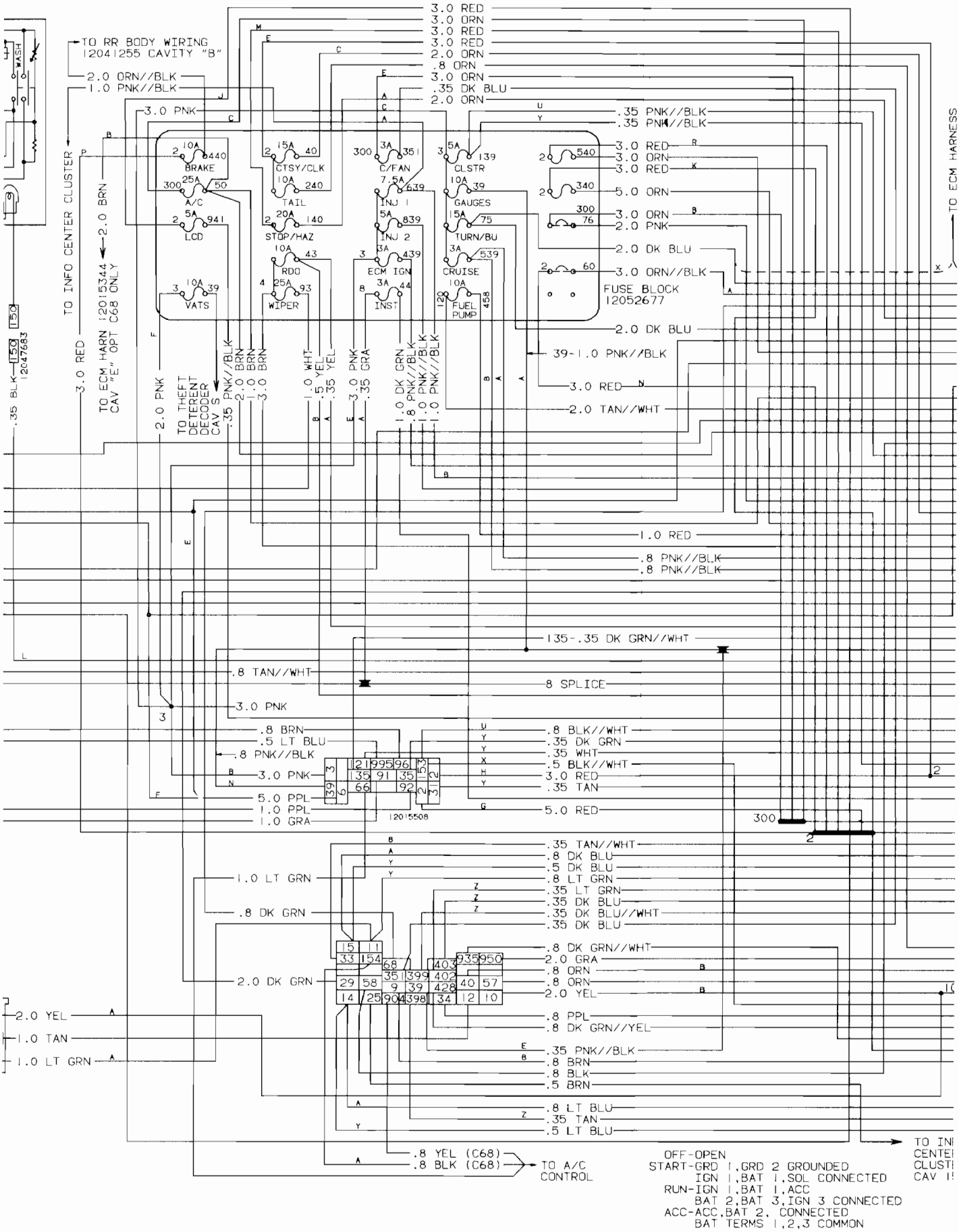

DOOR LOCK SOL
2.0 TAN
294
1.0 TAN
1.0 GRA
12052647
2.0 ORN//BLK
2.0 GRA
295
12045544
2.0 BRN
2.0 DK BLU
12004140
POWER WINDOW MOTOR
.8 BLK
.5 WHT
.8 ORN
.5 BLK
MAP LAMP
12020425
PWR DOOR LOCK SWITCH
LOCK
UNLOCK
12004680
TO IP HARN
.8 ORN
.5 WHT
.5 BLK
2.0 BLK
2.0 LT BLU
.5 BRN
.5 GRA
.5 LT GRN
.5 YEL
12041255
2.0 ORN//BLK
2.0 BLK
2.0 LT BLU
2.0 TAN
2.0 GRA
.5 YEL
.5 BLK
12010973
ARM SWITCH
.5 BLK
.5 LT GRN
8911773
DISARM SWITCH
.5 GRA
.5 BLK
12033746
DOOR AJAR SWITCH
.5 BRN
.5 WHT
12015199
HATCH RELEASE SWITCH
LEFT HAND DOOR WIRING
73
LH REAR WHEEL SENSOR

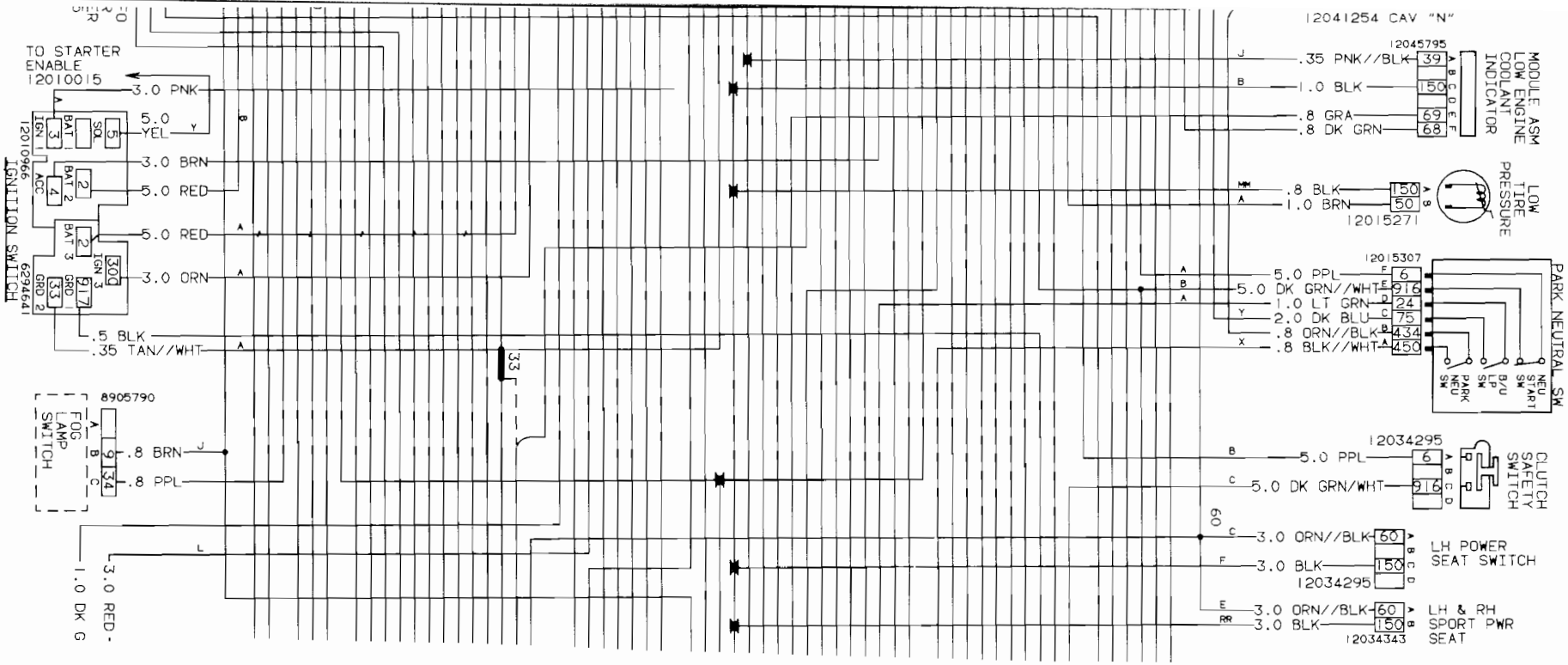

RH SIDE MARKER LAMP
RH CORNERING LAMP
RH PARK, DIR SIG LP
RH U/HOOD LP
HI-LO HD LP
RH HEAD LAMP ASSEMBLY
RH HDLAMP RLY
LH HDLAMP RLY
RH FOG LP
RH HORN
A/C SENSOR
LH HORN
LH FOG LP
LH U/HOOD LP
LH HEAD LAMP ASSEMBLY
HI LO HD LP
LH PARK, DIR SIG LP
LH SIDE MARKER LAMP
LH CORNERING LAMP
150 GROUND
LH GROUND
.8 DK BLU
.8 BRN
.8 BLK
1.0 BLK
1.0 LT GRN
1.0 TAN
2.0 DK GRN//WHT
2.0 WHT//BLK
2.0 RED
.8 PPL
2.0 BLK
2.0 BLK/GRN
.8 YEL
2.0 DK GRN
2.0 NAT WHT
3.0 BLK
.8 LT BLU
.8 ORN
.5 BLK
.5 ORN

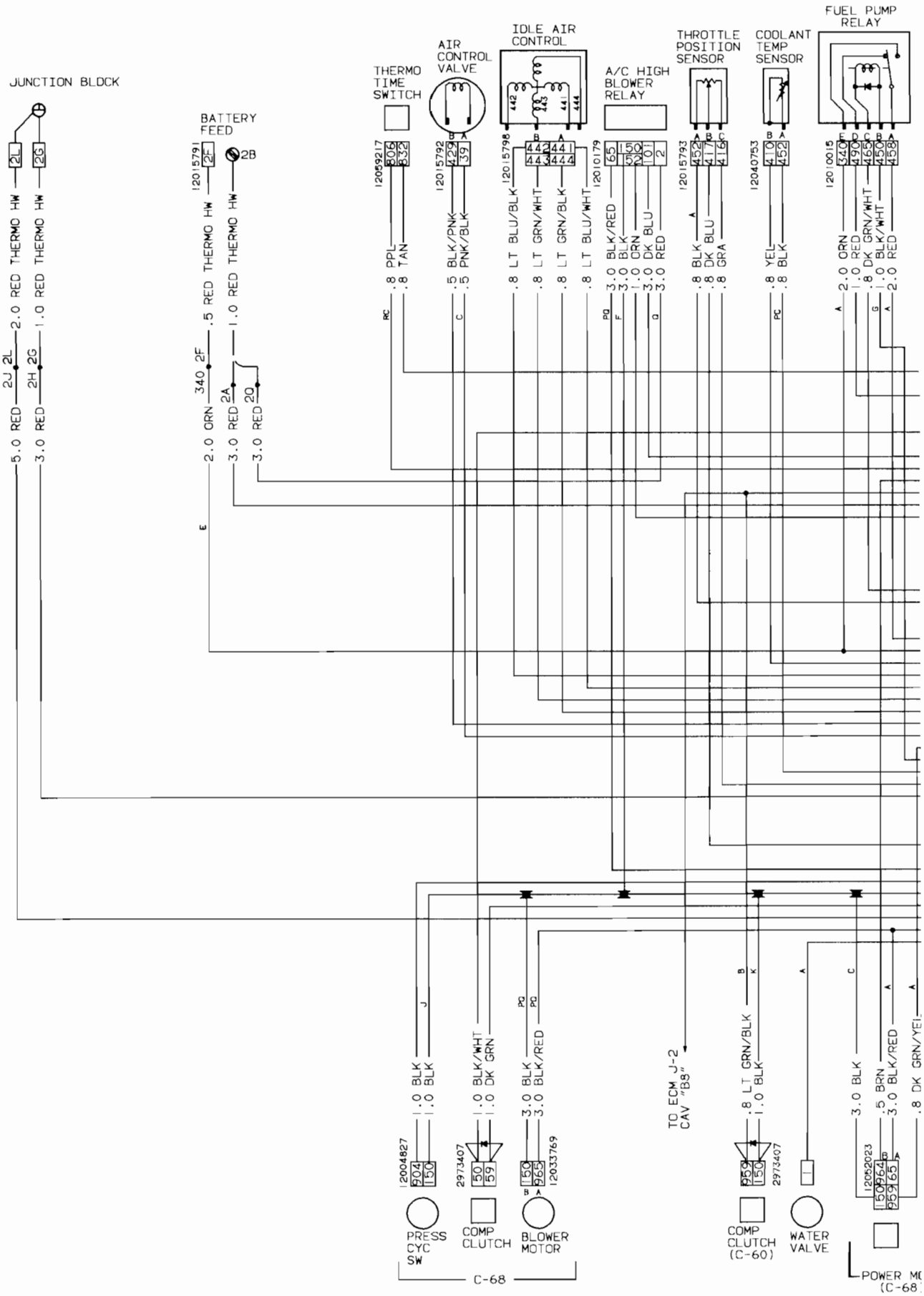
CORVETTE 1C


12010996
TO BATTERY CABLE
3.0 RED
3.0 RED
3.0 RED
12010973
HEAVY DUTY COOLING FAN V08
TO ELECTRONIC COOLING FAN
LOW COOLANT SENSOR
68
2977976
.8 DK GRN
903
151
12010973
151
902
12033769
3.0 BLK//RED
3.0 BLK
3.0 BLK
3.0 BLK//RED
151
GROUND
.8 RED THERMO HW
.8 RED THERMO HW
3.0 RED THERMO HW
1.0 RED THERMO HW
JUNCTION BLOCK
.8 DK BLU
12020266
2.0 YEL
2.0 GRA
1.0 BLK
2.0 RED
150
950
10
951
ISOLATION RELAY
.8 BLK
.5 DK GR
.8 BLK
.8 BLK
2.0 YEL
.5 ORN
.5 ORN
.8 DK BL
1.0 LT G
2.0 BLK/
.8 DK GR
1.0 TAN
1.0 LT G
CANISTER PURGE SOLENOID
39
428
12015978
ELECTRIC FAN RELAY
2
3.0 RED
351
.8 DK BLU
935
.8 DK GRN//WHT
902
3.0 BLK//RED
12010015
.8 DK

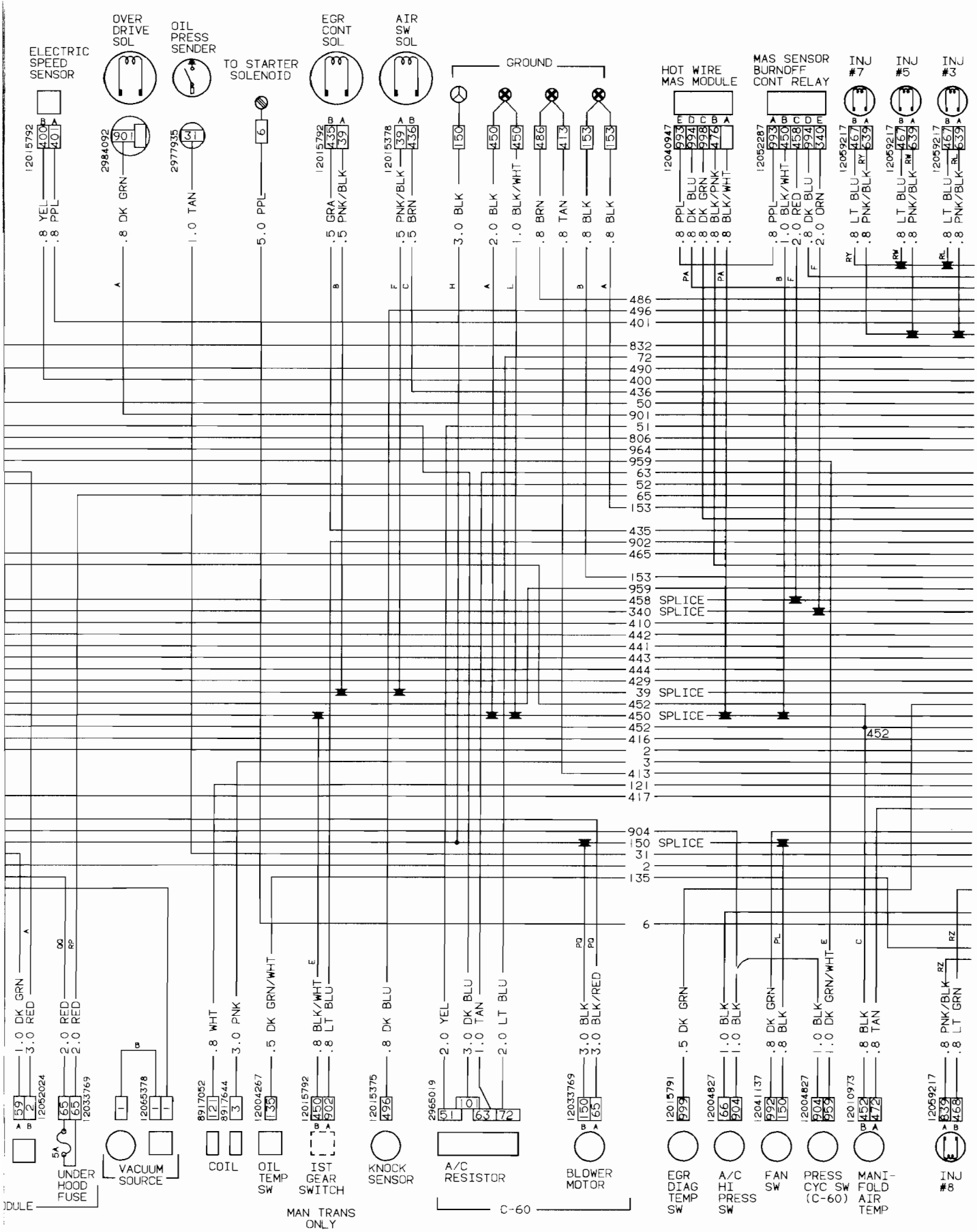

12020556
12034344
TO W/S WIPER MOTOR
92
991
.8 PPL
.8 GRA
92 A
991 B
TO ENGINE HARNESS
8917261
12010973
TO W/S WASHER PUMP
94
150
.8 PNK
.8 BLK
94 B
150 A
HI
LO
DELAY
OFF
MIST
W/S WIPER SWITCH
F E D C B A
12004706
96
995
91
92
93
8
.8 BRN
.5 LT BLU
1.0 GRA
1.0 PPL
1.0 WHT
.35 GRA
FUSE BLOCK
12065405
HATCH AUTO
3A
933
(916) 5.0 DK GRN//WHT
15A
THEFT
940
(2) 3.0 RED
5A
C INJ
806
(6) 3.0 PPL(AUTO)
(6) 3.0 PPL(MAN)
2.0 PNK
.8 PPL//WHT
.35 TAN//WHT
12010015
903
335
351
2
ELECTRIC FAN RELAY
OPT V08
2K
.0 RED
.0 RED
8 DK BLU
8 BRN
125
351
2
S
F
L
P
ALT
12045896
8911256
33
PARK BRAKE ALARM SWITCH
TO THEFT DETERRENT DECODER MODULE
12010123
.8 BRN
.8 YEL
12047663
922
921
STEERING COLUMN RESISTOR PELLET
DIMMER SW (COL MTD)
8917693
10
11
12
12015375
335
WATER TEMP SWITCH
N//WHT
.5 TAN/WHT
12020950
33
BRAKE SW (GIRLOCK)
12020646
.5 DK BLU
.5 TAN
.8 BLK
.5 LT BLU //BLK
.5 LT GRN
403
398
150
399
402
CRUISE CONT. SERVO
OPT K34
12015509
.8 ORN
2.0 GRA
.8 PPL
.8 PPL
.8 DK GRN//YEL
.8 PNK//BLK
1.0 TAN
.8 BRN
.8 BRN
.8 YEL
.8 LT BLU

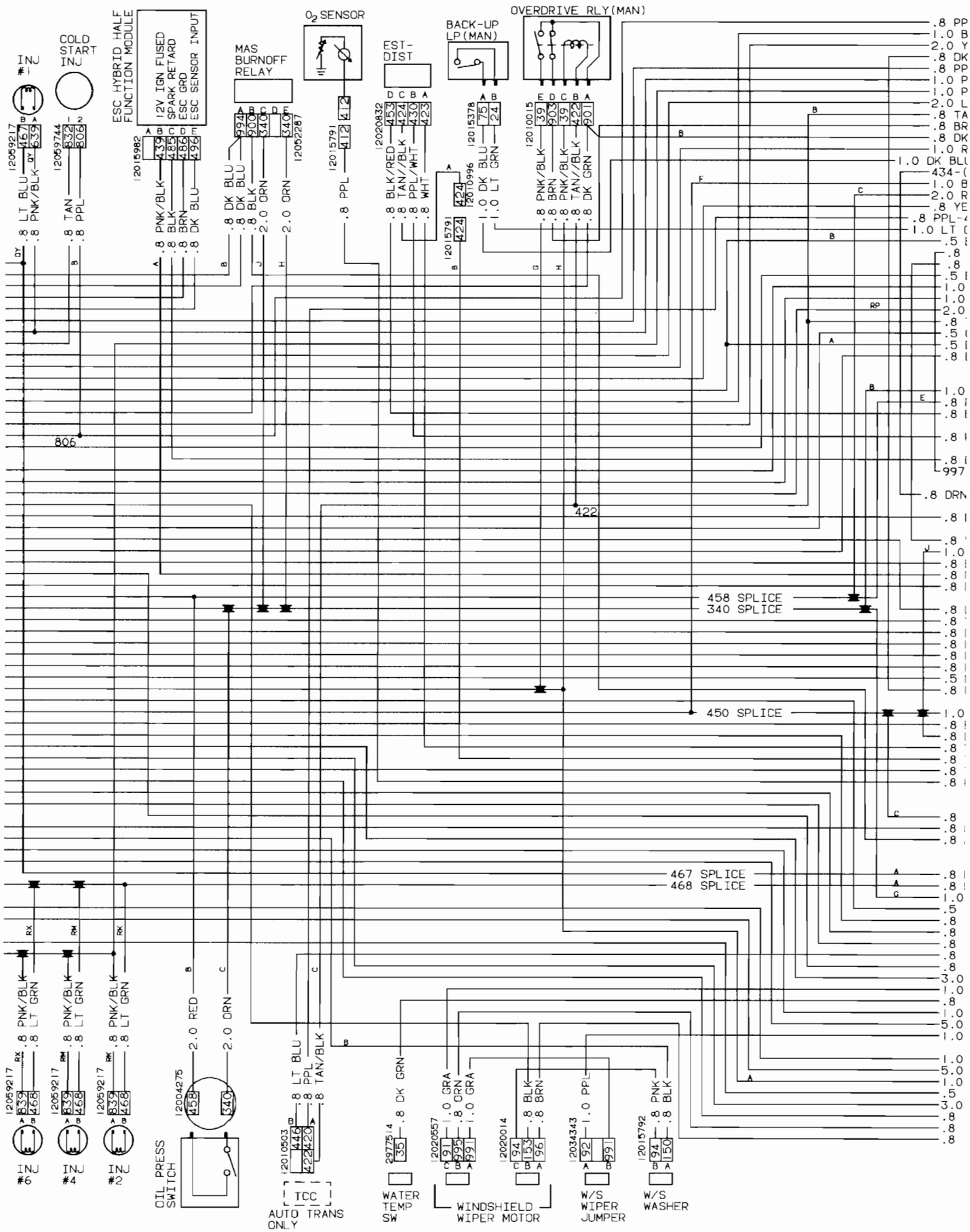

TO RR BODY WIRING 12041255 CAVITY "B"
2.0 ORN//BLK
1.0 PNK//BLK
3.0 PNK
TO INFO CENTER CLUSTER
3.0 RED
2.0 BRN
TO ECM HARN 12015344 CAV "E" OPT C68 ONLY
.35 BLK
150
12047683
WASH
10A 440 BRAKE
25A 300 50 A/C
5A 2 941 LCD
10A 3 39 VATS
15A 2 40 CTSY/CLK
10A 240 TAIL
20A 2 140 STOP/HAZ
10A 43 RDO
25A 4 93 WIPER
3A 300 351 C/FAN
7.5A 639 INJ 1
5A 839 INJ 2
3A 3 439 ECM IGN
3A 8 44 INST
5A 3 139 CLSTR
10A 39 GAUGES
15A 75 TURN/BU
3A 539 CRUISE
10A 120 458 FUEL PUMP
3.0 RED
3.0 ORN
3.0 RED
3.0 RED
2.0 ORN
.8 ORN
3.0 ORN
.35 DK BLU
2.0 ORN
.35 PNK//BLK
.35 PNK//BLK
3.0 RED 540
3.0 ORN
3.0 RED
5.0 ORN 340
3.0 ORN 300 76
2.0 PNK
2.0 DK BLU
3.0 ORN//BLK 60
FUSE BLOCK 12052677
TO ECM HARNESS
2.0 DK BLU
39-1.0 PNK//BLK
3.0 RED
2.0 TAN//WHT
TO THEFT DETERENT DECODER CAV 5
.35 PNK//BLK
2.0 BRN
2.0 BRN
1.0 BRN
3.0 BRN
1.0 WHT
.5 YEL
.35 YEL
3.0 PNK
.35 GRA
1.0 DK GRN
.8 PNK//BLK
1.0 PNK//BLK
1.0 PNK//BLK
2.0 PNK
1.0 RED
.8 PNK//BLK
.8 PNK//BLK
135-.35 DK GRN//WHT
.8 TAN//WHT
8 SPLICE
3.0 PNK
.8 BRN
.5 LT BLU
.8 PNK//BLK
3.0 PNK
5.0 PPL
1.0 PPL
1.0 GRA
12015508
.8 BLK//WHT
.35 DK GRN
.35 WHT
.5 BLK//WHT
3.0 RED
.35 TAN
5.0 RED
300
.35 TAN//WHT
.8 DK BLU
.5 DK BLU
.8 LT GRN
1.0 LT GRN
.35 LT GRN
.35 DK BLU
.35 DK BLU//WHT
.35 DK BLU
.8 DK GRN
.8 DK GRN//WHT
2.0 GRA
.8 ORN
.8 ORN
2.0 YEL
2.0 DK GRN
.8 PPL
.8 DK GRN//YEL
2.0 YEL
1.0 TAN
1.0 LT GRN
.35 PNK//BLK
.8 BRN
.8 BLK
.5 BRN
.8 LT BLU
.35 TAN
.5 LT BLU
.8 YEL (C68)
.8 BLK (C68)
TO A/C CONTROL
OFF-OPEN
START-GRD 1,GRD 2 GROUNDED
IGN 1,BAT 1,SOL CONNECTED
RUN-IGN 1,BAT 1,ACC
BAT 2,BAT 3,IGN 3 CONNECTED
ACC-ACC,BAT 2, CONNECTED
BAT TERMS 1,2,3 COMMON

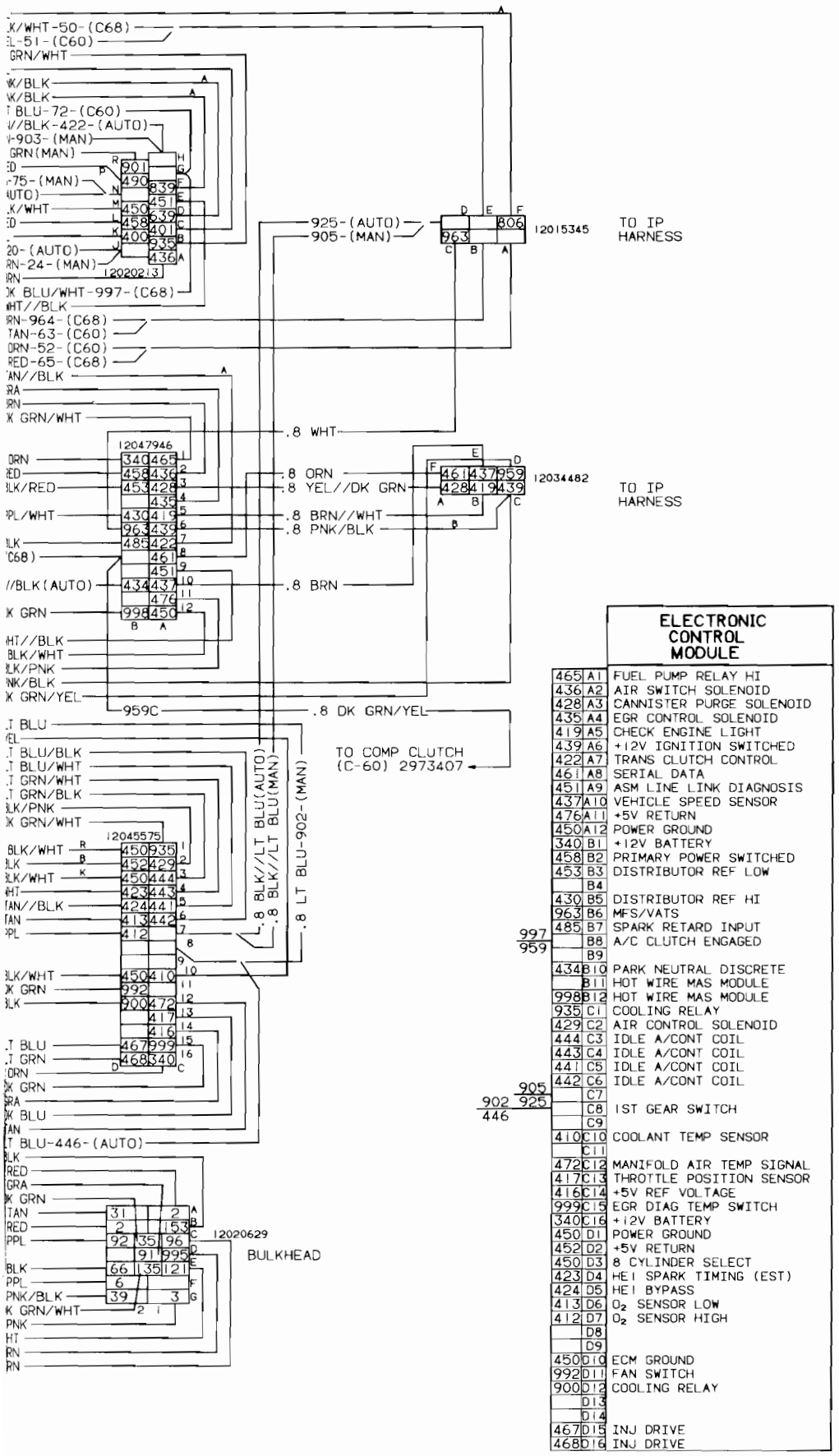

TO STARTER ENABLE 12010015
3.0 PNK
5.0 YEL
3.0 BRN
5.0 RED
5.0 RED
3.0 ORN
.5 BLK
.35 TAN//WHT
IGNITION SWITCH
12010966
6294641
IGN 1
BAT 1
SOL
BAT 2
ACC
BAT 3
IGN 3
GRD
GRD 2
8905790
FOG LAMP SWITCH
.8 BRN
.8 PPL
1.0 DK G
3.0 RED
12041254 CAV "N"
12045795
.35 PNK//BLK
1.0 BLK
.8 GRA
.8 DK GRN
MODULE ASM LOW ENGINE COOLANT INDICATOR
.8 BLK
1.0 BRN
12015271
LOW TIRE PRESSURE
12015307
5.0 PPL
5.0 DK GRN//WHT
1.0 LT GRN
2.0 DK BLU
.8 ORN//BLK
.8 BLK//WHT
PARK NEUTRAL SW
NEU START SW
B/U LP SW
PARK NEU SW
12034295
5.0 PPL
5.0 DK GRN/WHT
CLUTCH SAFETY SWITCH
3.0 ORN//BLK
3.0 BLK
LH POWER SEAT SWITCH
12034295
3.0 ORN//BLK
3.0 BLK
LH & RH SPORT PWR SEAT
12034343


JUNCTION BLOCK
BATTERY FEED
THERMO TIME SWITCH
AIR CONTROL VALVE
IDLE AIR CONTROL
A/C HIGH BLOWER RELAY
THROTTLE POSITION SENSOR
COOLANT TEMP SENSOR
FUEL PUMP RELAY
PRESS CYC SW
COMP CLUTCH
BLOWER MOTOR
COMP CLUTCH (C-60)
WATER VALVE
C-68
TO ECM J-2 CAV "B8"

CORVETTE 1E

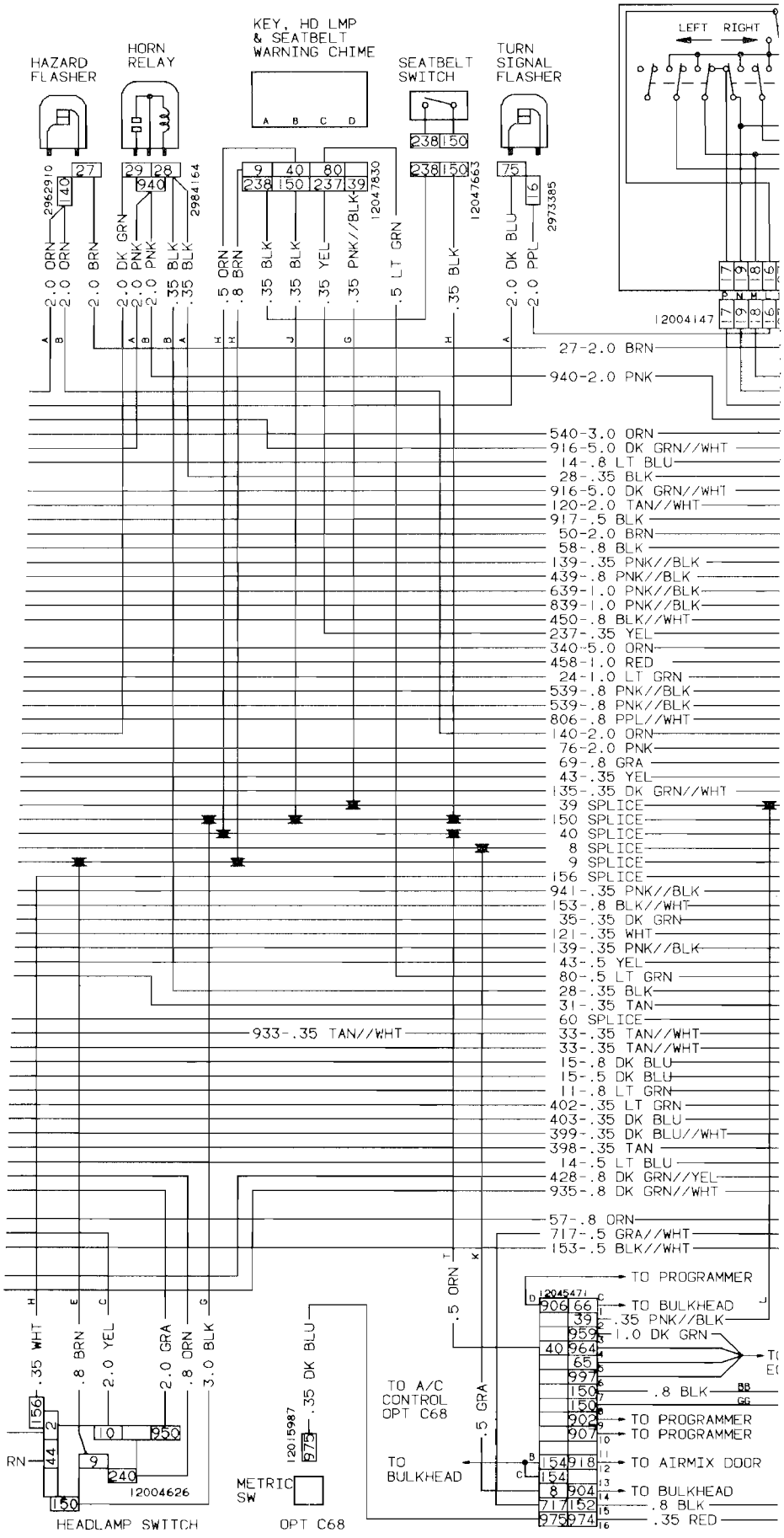

ELECTRIC SPEED SENSOR
OVER DRIVE SOL
OIL PRESS SENDER
TO STARTER SOLENOID
EGR CONT SOL
AIR SW SOL
GROUND
HOT WIRE MAS MODULE
MAS SENSOR BURNOFF CONT RELAY
INJ #7
INJ #5
INJ #3
SPLICE
MAN TRANS ONLY
C-60
UNDER HOOD FUSE
VACUUM SOURCE
COIL
OIL TEMP SW
IST GEAR SWITCH
KNOCK SENSOR
A/C RESISTOR
BLOWER MOTOR
EGR DIAG TEMP SW
A/C HI PRESS SW
FAN SW
PRESS CYC SW (C-60)
MANI-FOLD AIR TEMP
INJ #8

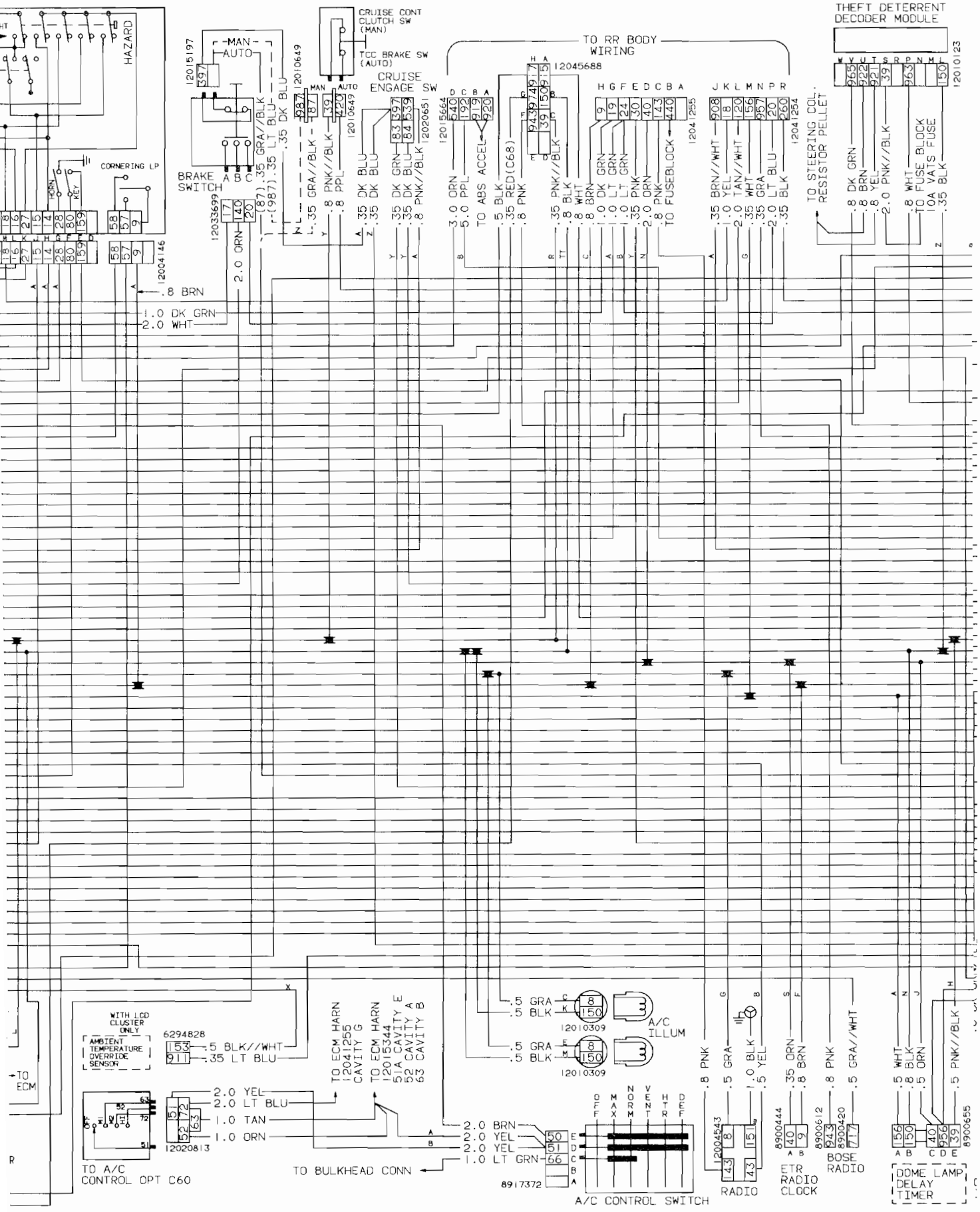

INJ #1
COLD START INJ
ESC HYBRID HALF FUNCTION MODULE
12V IGN FUSED
SPARK RETARD
ESC GRD
ESC SENSOR INPUT
MAS BURNOFF RELAY
O2 SENSOR
EST-DIST
BACK-UP LP(MAN)
OVERDRIVE RLY(MAN)
458 SPLICE
340 SPLICE
450 SPLICE
467 SPLICE
468 SPLICE
INJ #6
INJ #4
INJ #2
OIL PRESS SWITCH
TCC
AUTO TRANS ONLY
WATER TEMP SW
WINDSHIELD WIPER MOTOR
W/S WIPER JUMPER
W/S WASHER

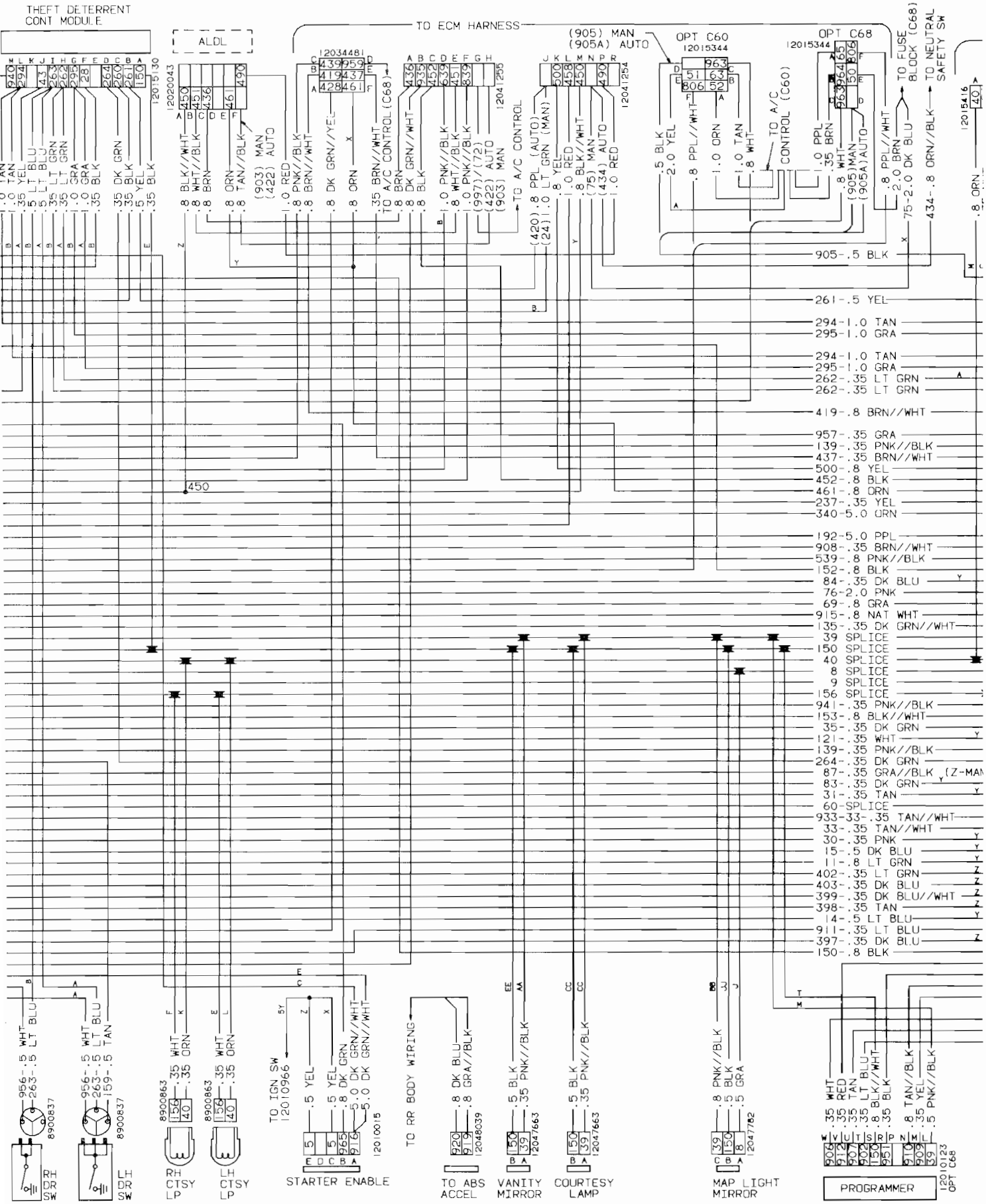


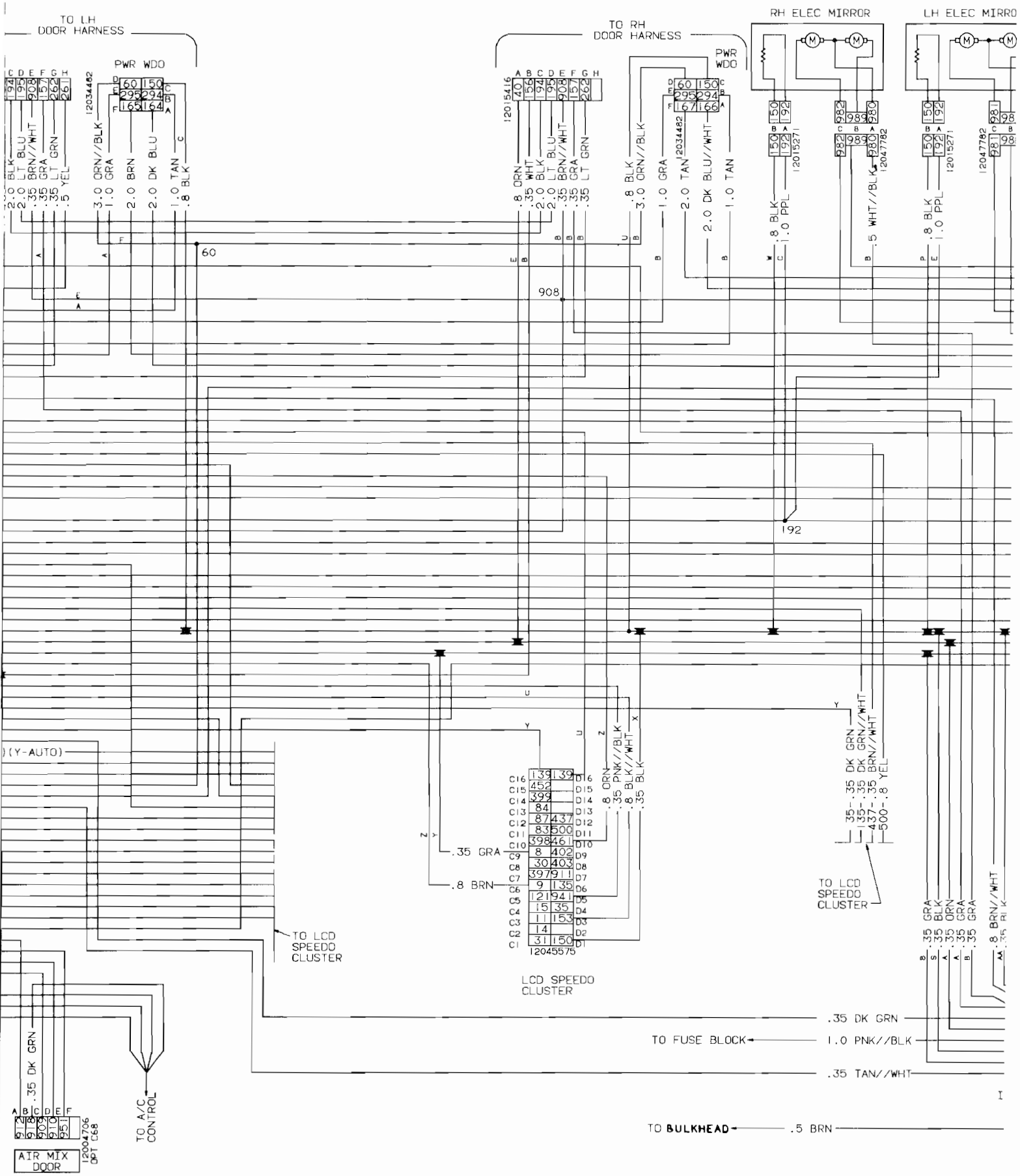
ELECTRONIC CONTROL MODULE

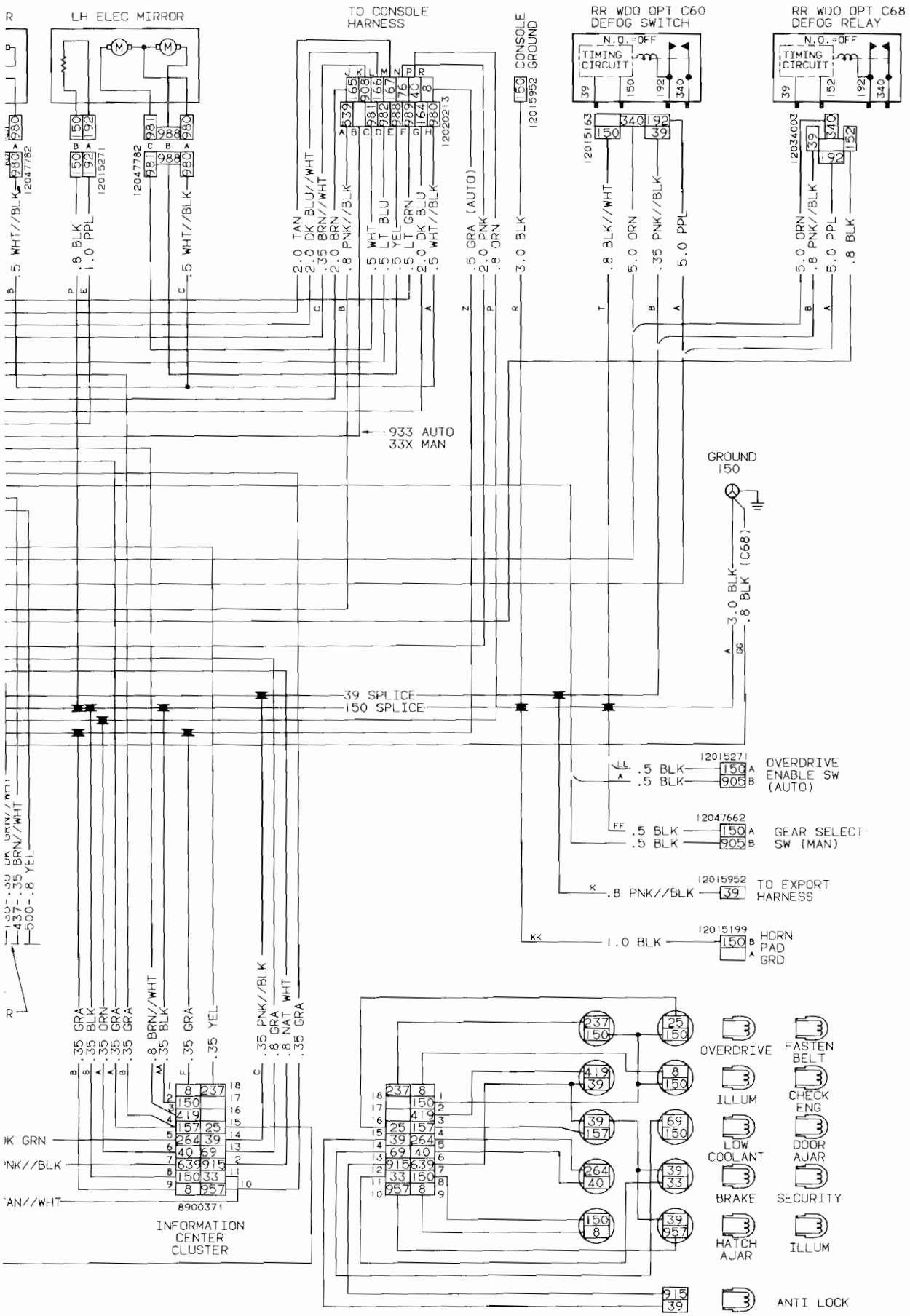
465	A1	FUEL PUMP RELAY HI
436	A2	AIR SWITCH SOLENOID
428	A3	CANNISTER PURGE SOLENOID
435	A4	EGR CONTROL SOLENOID
419	A5	CHECK ENGINE LIGHT
439	A6	+12V IGNITION SWITCHED
422	A7	TRANS CLUTCH CONTROL
461	A8	SERIAL DATA
451	A9	ASM LINE LINK DIAGNOSIS
437	A10	VEHICLE SPEED SENSOR
476	A11	+5V RETURN
450	A12	POWER GROUND
340	B1	+12V BATTERY
458	B2	PRIMARY POWER SWITCHED
453	B3	DISTRIBUTOR REF LOW
	B4	
430	B5	DISTRIBUTOR REF HI
963	B6	MFS/VATS
485	B7	SPARK RETARD INPUT
997 / 959	B8	A/C CLUTCH ENGAGED
	B9	
434	B10	PARK NEUTRAL DISCRETE
	B11	HOT WIRE MAS MODULE
998	B12	HOT WIRE MAS MODULE
935	C1	COOLING RELAY
429	C2	AIR CONTROL SOLENOID
444	C3	IDLE A/CONT COIL
443	C4	IDLE A/CONT COIL
441	C5	IDLE A/CONT COIL
442	C6	IDLE A/CONT COIL
905	C7	
902 / 925 / 446	C8	1ST GEAR SWITCH
	C9	
410	C10	COOLANT TEMP SENSOR
	C11	
472	C12	MANIFOLD AIR TEMP SIGNAL
417	C13	THROTTLE POSITION SENSOR
416	C14	+5V REF VOLTAGE
999	C15	EGR DIAG TEMP SWITCH
340	C16	+12V BATTERY
450	D1	POWER GROUND
452	D2	+5V RETURN
450	D3	8 CYLINDER SELECT
423	D4	HEI SPARK TIMING (EST)
424	D5	HEI BYPASS
413	D6	O_2 SENSOR LOW
412	D7	O_2 SENSOR HIGH
	D8	
	D9	
450	D10	ECM GROUND
992	D11	FAN SWITCH
900	D12	COOLING RELAY
	D13	
	D14	
467	D15	INJ DRIVE
468	D16	INJ DRIVE


HAZARD FLASHER
HORN RELAY
KEY, HD LMP & SEATBELT WARNING CHIME
SEATBELT SWITCH
TURN SIGNAL FLASHER
LEFT RIGHT
27-2.0 BRN
940-2.0 PNK
540-3.0 ORN
916-5.0 DK GRN//WHT
14-.8 LT BLU
28-.35 BLK
916-5.0 DK GRN//WHT
120-2.0 TAN//WHT
917-.5 BLK
50-2.0 BRN
58-.8 BLK
139-.35 PNK//BLK
439-.8 PNK//BLK
639-1.0 PNK//BLK
839-1.0 PNK//BLK
450-.8 BLK//WHT
237-.35 YEL
340-5.0 ORN
458-1.0 RED
24-1.0 LT GRN
539-.8 PNK//BLK
539-.8 PNK//BLK
806-.8 PPL//WHT
140-2.0 ORN
76-2.0 PNK
69-.8 GRA
43-.35 YEL
135-.35 DK GRN//WHT
39 SPLICE
150 SPLICE
40 SPLICE
8 SPLICE
9 SPLICE
156 SPLICE
941-.35 PNK//BLK
153-.8 BLK//WHT
35-.35 DK GRN
121-.35 WHT
139-.35 PNK//BLK
43-.5 YEL
80-.5 LT GRN
28-.35 BLK
31-.35 TAN
60 SPLICE
933-.35 TAN//WHT
33-.35 TAN//WHT
33-.35 TAN//WHT
15-.8 DK BLU
15-.5 DK BLU
11-.8 LT GRN
402-.35 LT GRN
403-.35 DK BLU
399-.35 DK BLU//WHT
398-.35 TAN
14-.5 LT BLU
428-.8 DK GRN//YEL
935-.8 DK GRN//WHT
57-.8 ORN
717-.5 GRA//WHT
153-.5 BLK//WHT
TO PROGRAMMER
TO BULKHEAD
.35 PNK//BLK
1.0 DK GRN
.8 BLK
TO PROGRAMMER
TO PROGRAMMER
TO AIRMIX DOOR
TO BULKHEAD
.8 BLK
.35 RED
TO A/C CONTROL OPT C68
TO BULKHEAD
.35 WHT
.8 BRN
2.0 YEL
2.0 GRA
.8 ORN
3.0 BLK
.35 DK BLU
.5 ORN
.5 GRA
RN
METRIC SW
HEADLAMP SWITCH
OPT C68
12004626
12004147

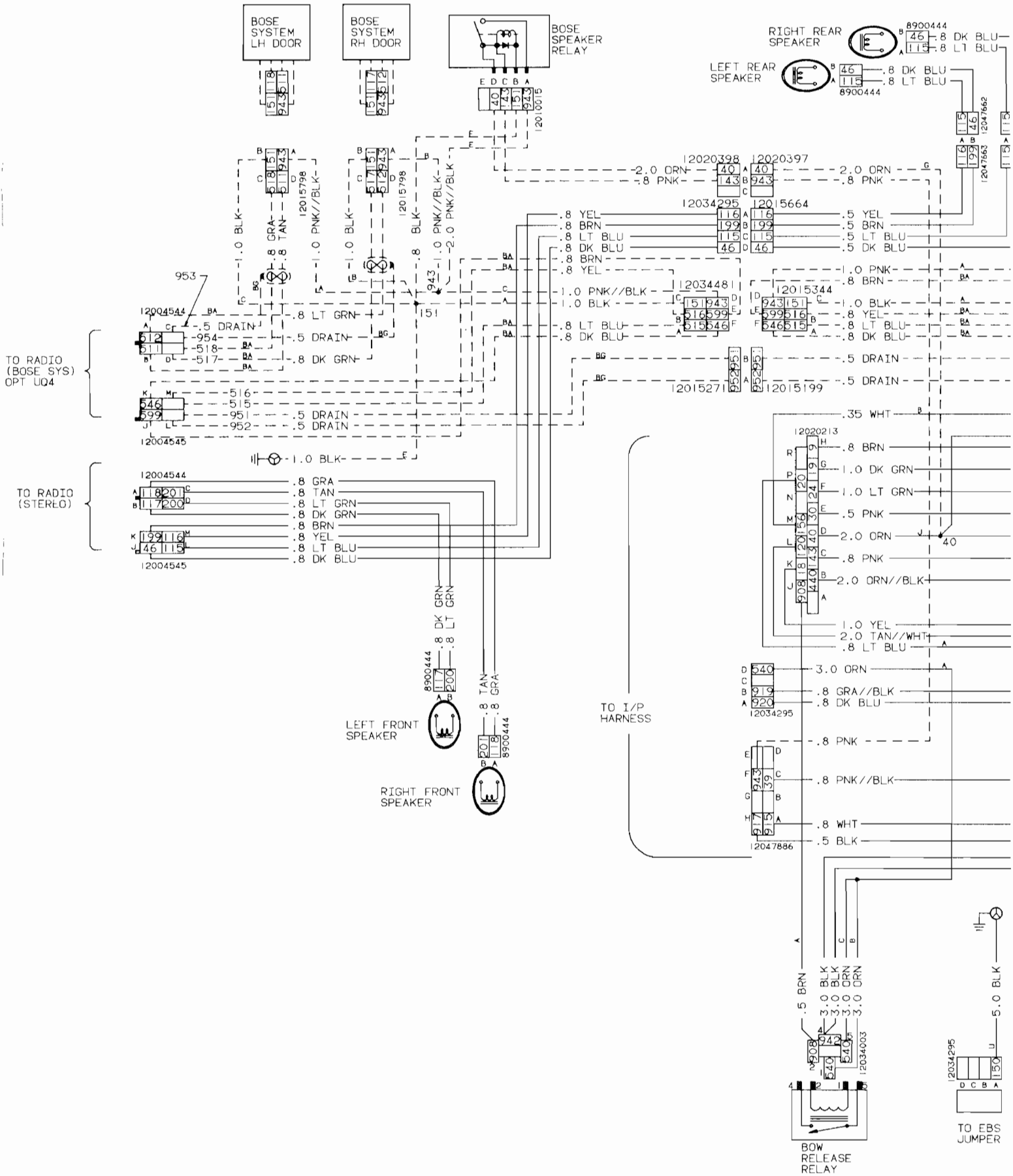

HAZARD
CORNERING LP
HORN
KEY
12004146
BRAKE SWITCH
-MAN-
AUTO
12015197
12010649
CRUISE CONT CLUTCH SW (MAN)
TCC BRAKE SW (AUTO)
CRUISE ENGAGE SW
12033699
12020651
12015664
TO ABS ACCEL
TO RR BODY WIRING
12045688
12041255
12041254
THEFT DETERRENT DECODER MODULE
12010123
TO STEERING COL. RESISTOR PELLET
TO FUSE BLOCK
10A VATS FUSE
.8 BRN
1.0 DK GRN
2.0 WHT
.8 DK GRN
.8 BRN
.8 YEL
2.0 PNK//BLK
.8 WHT
.35 BLK
.8 PNK//BLK
.35 GRA//BLK
.35 LT BLU
.35 DK BLU
.35 GRA//BLK
.8 PNK//BLK
.8 PPL
.35 DK BLU
.35 DK GRN
.35 DK BLU
3.0 ORN
5.0 PPL
.5 BLK
.35 RED(C68)
.8 PNK
.35 PNK//BLK
.8 BLK
.8 WHT
.8 BRN
1.0 DK GRN
1.0 LT GRN
1.0 LT GRN
.35 PNK
2.0 ORN
.8 PNK
TO FUSEBLOCK
.35 BRN//WHT
1.0 YEL
2.0 TAN//WHT
.35 WHT
.35 GRA
2.0 LT BLU
.35 BLK
WITH LCD CLUSTER ONLY
AMBIENT TEMPERATURE OVERRIDE SENSOR
6294828
.5 BLK//WHT
.35 LT BLU
TO ECM
2.0 YEL
2.0 LT BLU
1.0 TAN
1.0 ORN
12020813
TO A/C CONTROL OPT C60
TO ECM HARN 12041255 CAVITY G
TO ECM HARN 12015344 51A CAVITY E 52 CAVITY A 63 CAVITY B
2.0 BRN
2.0 YEL
2.0 YEL
1.0 LT GRN
TO BULKHEAD CONN
8917372
.5 GRA
.5 BLK
12010309
A/C ILLUM
.5 GRA
.5 BLK
12010309
A/C CONTROL SWITCH
.8 PNK
.5 GRA
1.0 BLK
.5 YEL
12004543
RADIO
.35 ORN
.8 BRN
8900444
8900612
ETR RADIO CLOCK
.8 PNK
.5 GRA//WHT
8900420
BOSE RADIO
.5 WHT
.8 BLK
.5 ORN
.5 PNK//BLK
8900655
DOME LAMP DELAY TIMER

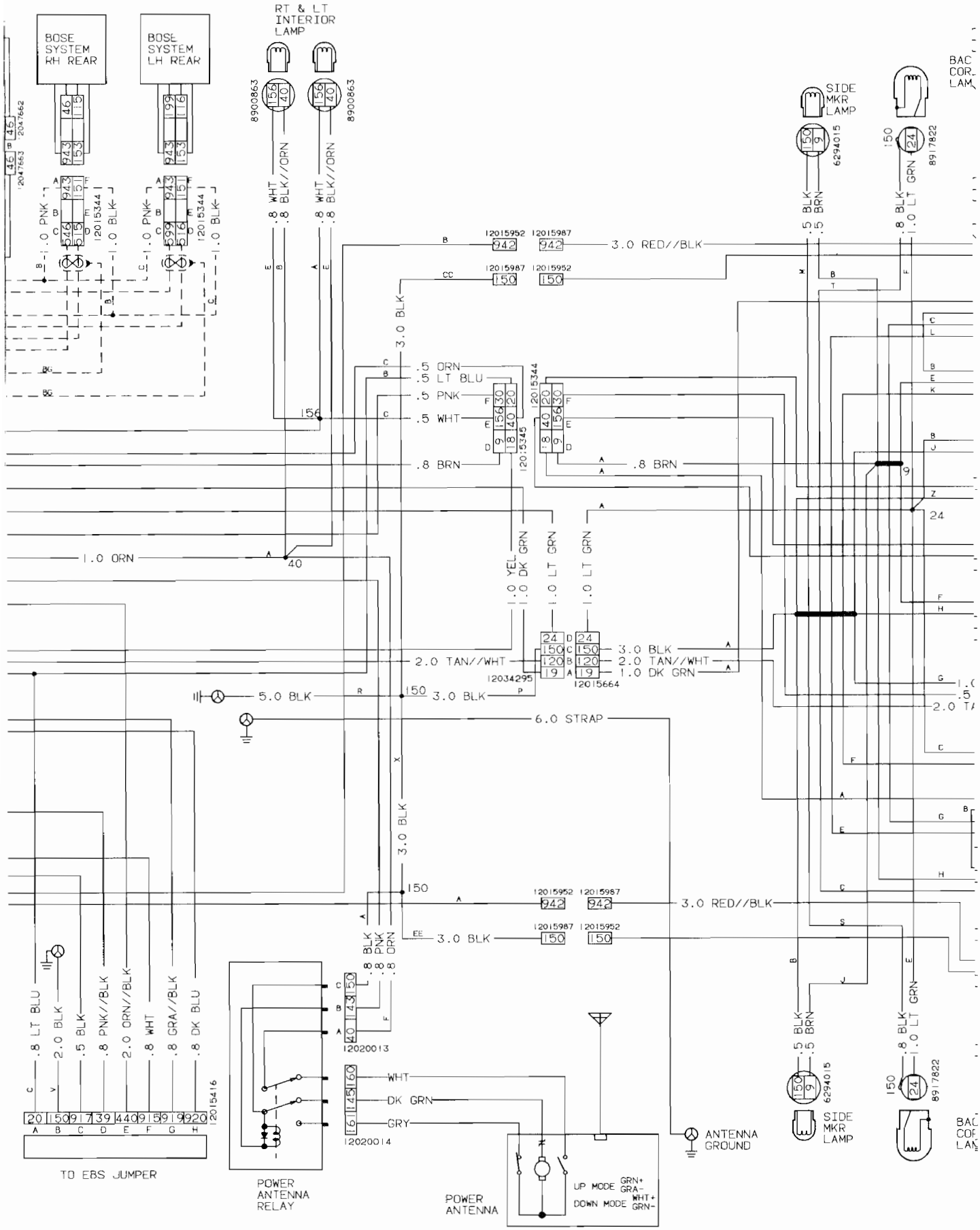

THEFT DETERRENT CONT MODULE
ALDL
TO ECM HARNESS
(905) MAN
(905A) AUTO
OPT C60
12015344
OPT C68
12015344
TO A/C CONTROL (C60)
TO FUSE BLOCK (C68)
TO NEUTRAL SAFETY SW
TO A/C CONTROL
905-.5 BLK
261-.5 YEL
294-1.0 TAN
295-1.0 GRA
262-.35 LT GRN
419-.8 BRN//WHT
957-.35 GRA
139-.35 PNK//BLK
437-.35 BRN//WHT
500-.8 YEL
452-.8 BLK
461-.8 ORN
237-.35 YEL
340-5.0 ORN
192-5.0 PPL
908-.35 BRN//WHT
539-.8 PNK//BLK
152-.8 BLK
84-.35 DK BLU
76-2.0 PNK
69-.8 GRA
915-.8 NAT WHT
135-.35 DK GRN//WHT
39 SPLICE
150 SPLICE
40 SPLICE
8 SPLICE
9 SPLICE
156 SPLICE
941-.35 PNK//BLK
153-.8 BLK//WHT
35-.35 DK GRN
121-.35 WHT
139-.35 PNK//BLK
264-.35 DK GRN
87-.35 GRA//BLK
83-.35 DK GRN
31-.35 TAN
60-SPLICE
933-33-.35 TAN//WHT
33-.35 TAN//WHT
30-.35 PNK
15-.5 DK BLU
11-.8 LT GRN
402-.35 LT GRN
403-.35 DK BLU
399-.35 DK BLU//WHT
398-.35 TAN
14-.5 LT BLU
911-.35 LT BLU
397-.35 DK BLU
150-.8 BLK
956-.5 WHT
263-.5 LT BLU
159-.5 TAN
RH DR SW
LH DR SW
RH CTSY LP
LH CTSY LP
TO IGN SW
STARTER ENABLE
TO RR BODY WIRING
TO ABS ACCEL
VANITY MIRROR
COURTESY LAMP
MAP LIGHT MIRROR
PROGRAMMER
12010123
OPT C68

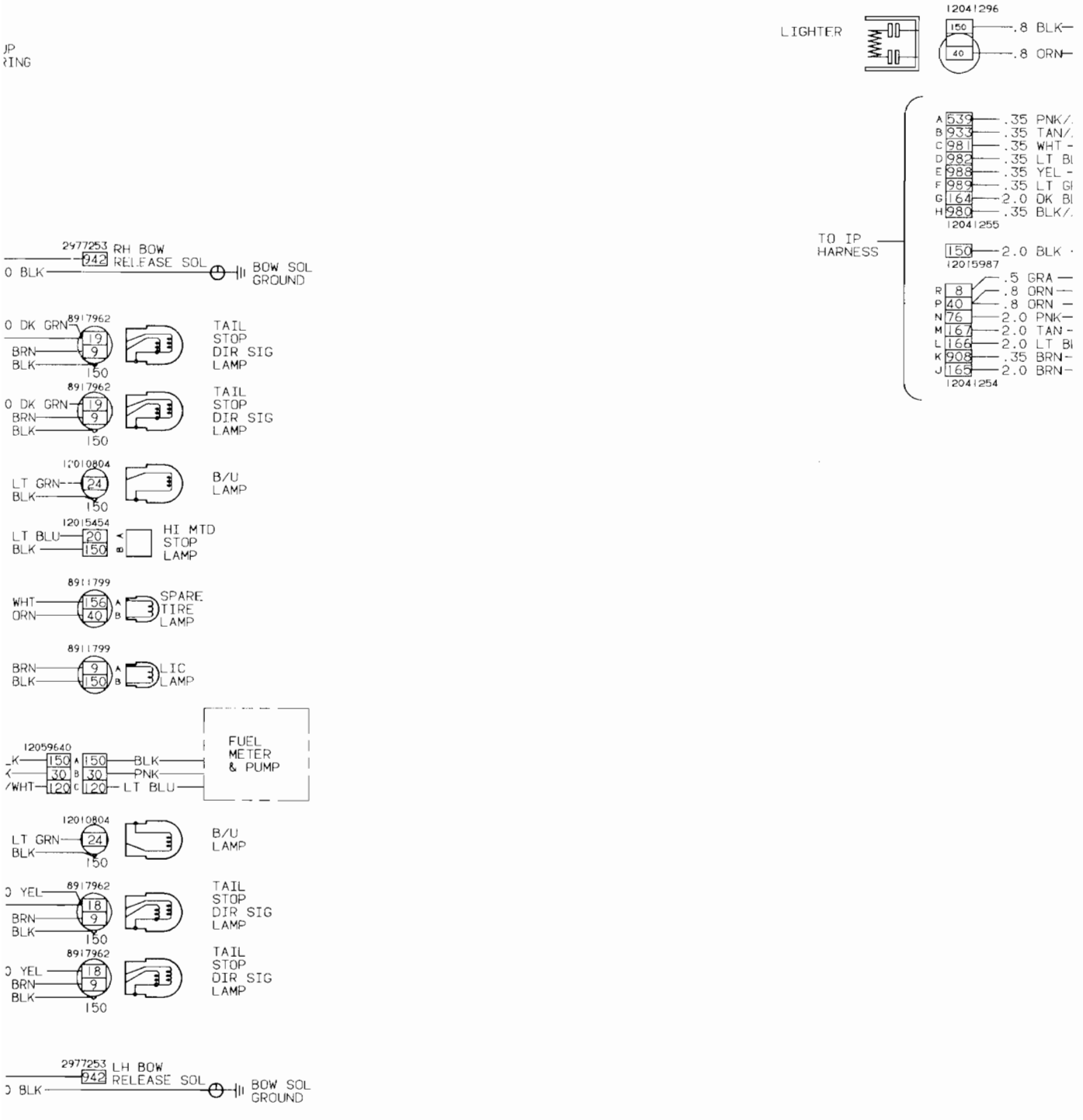

TO LH DOOR HARNESS
PWR WDO
12034482
C D E F G H
194 195 908 157 262 261
2.0 BLK
2.0 LT BLU
.35 BRN//WHT
.35 GRA
.35 LT GRN
.5 YEL
D 60 150 C
E 295 294 B
F 165 164 A
3.0 ORN//BLK
1.0 GRA
2.0 BRN
2.0 DK BLU
1.0 TAN
.8 BLK
60
908
TO RH DOOR HARNESS
12015416
A B C D E F G H
40 56 194 195 908 157 262
.8 ORN
.35 WHT
2.0 BLK
2.0 LT BLU
.35 BRN//WHT
.35 GRA
.35 LT GRN
.8 BLK
3.0 ORN//BLK
1.0 GRA
2.0 TAN
2.0 DK BLU//WHT
1.0 TAN
RH ELEC MIRROR
LH ELEC MIRRO
150 192
12015271
982 989 980
12047782
.8 BLK
1.0 PPL
.5 WHT//BLK
192
(Y-AUTO)
C16 139 139 D16
C15 452 D15
C14 399 D14
C13 84 D13
C12 87 437 D12
C11 83 500 D11
C10 398 46 D10
C9 8 402 D9
C8 30 403 D8
C7 397 9 11 D7
C6 9 135 D6
C5 12 194 D5
C4 15 35 D4
C3 11 153 D3
C2 14 D2
C1 31 150 D1
12045575
.35 GRA
.8 BRN
.8 ORN
.35 PNK//BLK
.8 BLK//WHT
.35 BLK
.35 DK GRN
.35 DK GRN//WHT
.35 BRN//WHT
.8 YEL
TO LCD SPEEDO CLUSTER
LCD SPEEDO CLUSTER
.35 GRA
.35 BLK
.35 ORN
.35 GRA
.35 GRA
.8 BRN//WHT
.35 DK GRN
TO FUSE BLOCK
1.0 PNK//BLK
.35 TAN//WHT
TO A/C CONTROL
A B C D E F
.35 DK GRN
AIR MIX DOOR
12004706
DPT C68
TO BULKHEAD
.5 BRN


LH ELEC MIRROR
TO CONSOLE HARNESS
CONSOLE GROUND
RR WDO OPT C60 DEFOG SWITCH
RR WDO OPT C68 DEFOG RELAY
TIMING CIRCUIT
933 AUTO
33X MAN
GROUND 150
39 SPLICE
150 SPLICE
OVERDRIVE ENABLE SW (AUTO)
GEAR SELECT SW (MAN)
TO EXPORT HARNESS
HORN PAD GRD
OVERDRIVE
FASTEN BELT
ILLUM
CHECK ENG
LOW COOLANT
DOOR AJAR
BRAKE
SECURITY
HATCH AJAR
ILLUM
ANTI LOCK
INFORMATION CENTER CLUSTER
8900371

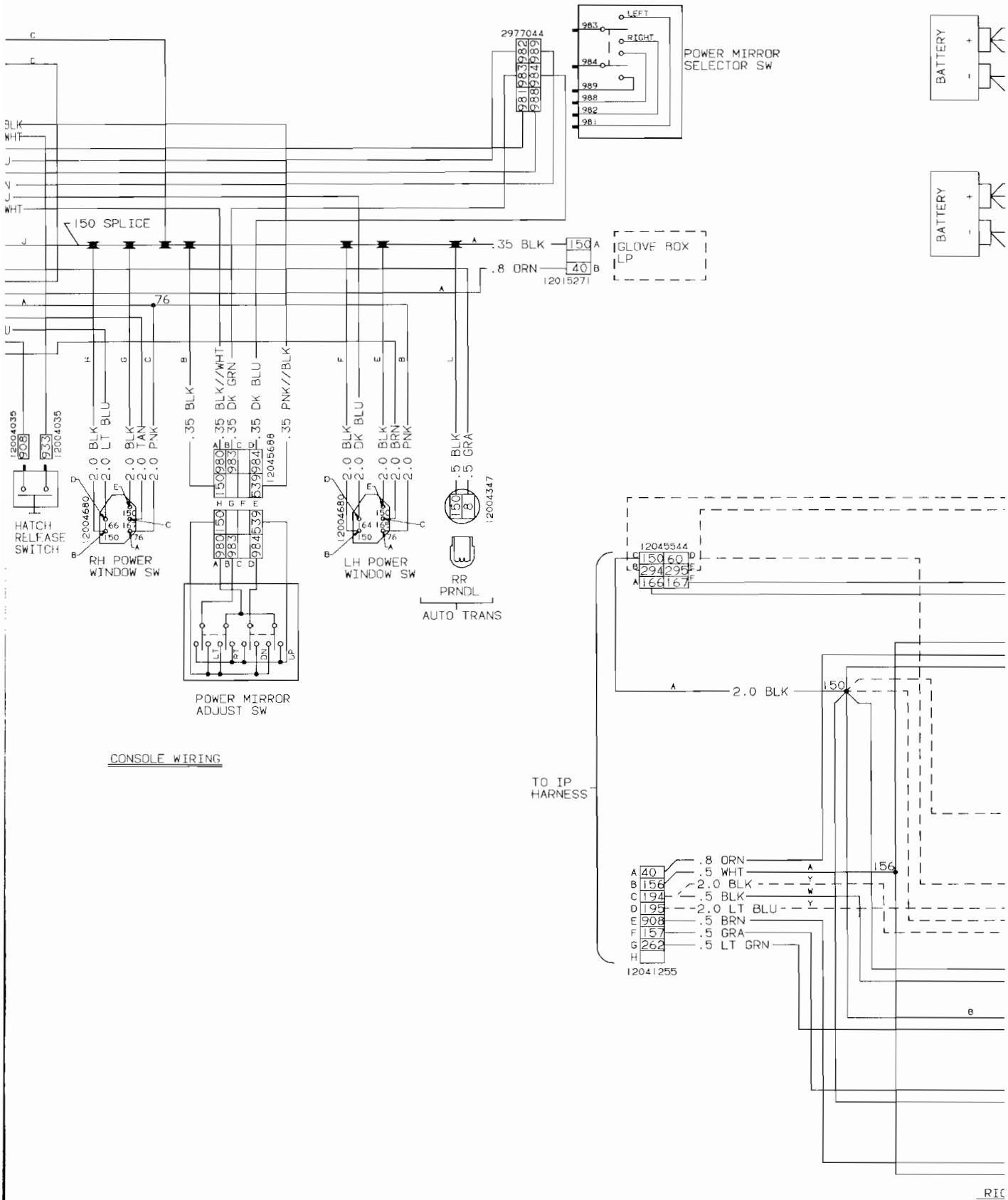
CORVETTE 1D


BOSE SYSTEM LH DOOR
BOSE SYSTEM RH DOOR
BOSE SPEAKER RELAY
RIGHT REAR SPEAKER
LEFT REAR SPEAKER
8900444
.8 DK BLU
.8 LT BLU
12020398
12020397
2.0 ORN
.8 PNK
12034295
12015664
.8 YEL
.8 BRN
.8 LT BLU
.8 DK BLU
.5 YEL
.5 BRN
.5 LT BLU
.5 DK BLU
12015798
1.0 BLK
.8 GRA
.8 TAN
1.0 PNK//BLK
2.0 PNK//BLK
.8 BLK
953
943
151
12034481
12015344
1.0 PNK
1.0 BLK
.8 YEL
.8 BRN
.8 LT BLU
.8 DK BLU
12004544
.8 LT GRN
.5 DRAIN
.8 DK GRN
954
518
517
TO RADIO (BOSE SYS) OPT UQ4
516
515
951
952
12004545
12015271
12015199
.35 WHT
12020213
.8 BRN
1.0 DK GRN
1.0 LT GRN
.5 PNK
2.0 ORN
.8 PNK
2.0 ORN//BLK
40
TO RADIO (STEREO)
.8 GRA
.8 TAN
.8 LT GRN
.8 DK GRN
.8 BRN
.8 YEL
.8 LT BLU
.8 DK BLU
1.0 YEL
2.0 TAN//WHT
.8 LT BLU
3.0 ORN
.8 GRA//BLK
.8 DK BLU
12034295
TO I/P HARNESS
.8 PNK
.8 PNK//BLK
.8 WHT
.5 BLK
12047886
LEFT FRONT SPEAKER
RIGHT FRONT SPEAKER
.8 DK GRN
.8 LT GRN
.8 TAN
.8 GRA
.5 BRN
3.0 BLK
3.0 ORN
5.0 BLK
12034003
BOW RELEASE RELAY
TO EBS JUMPER

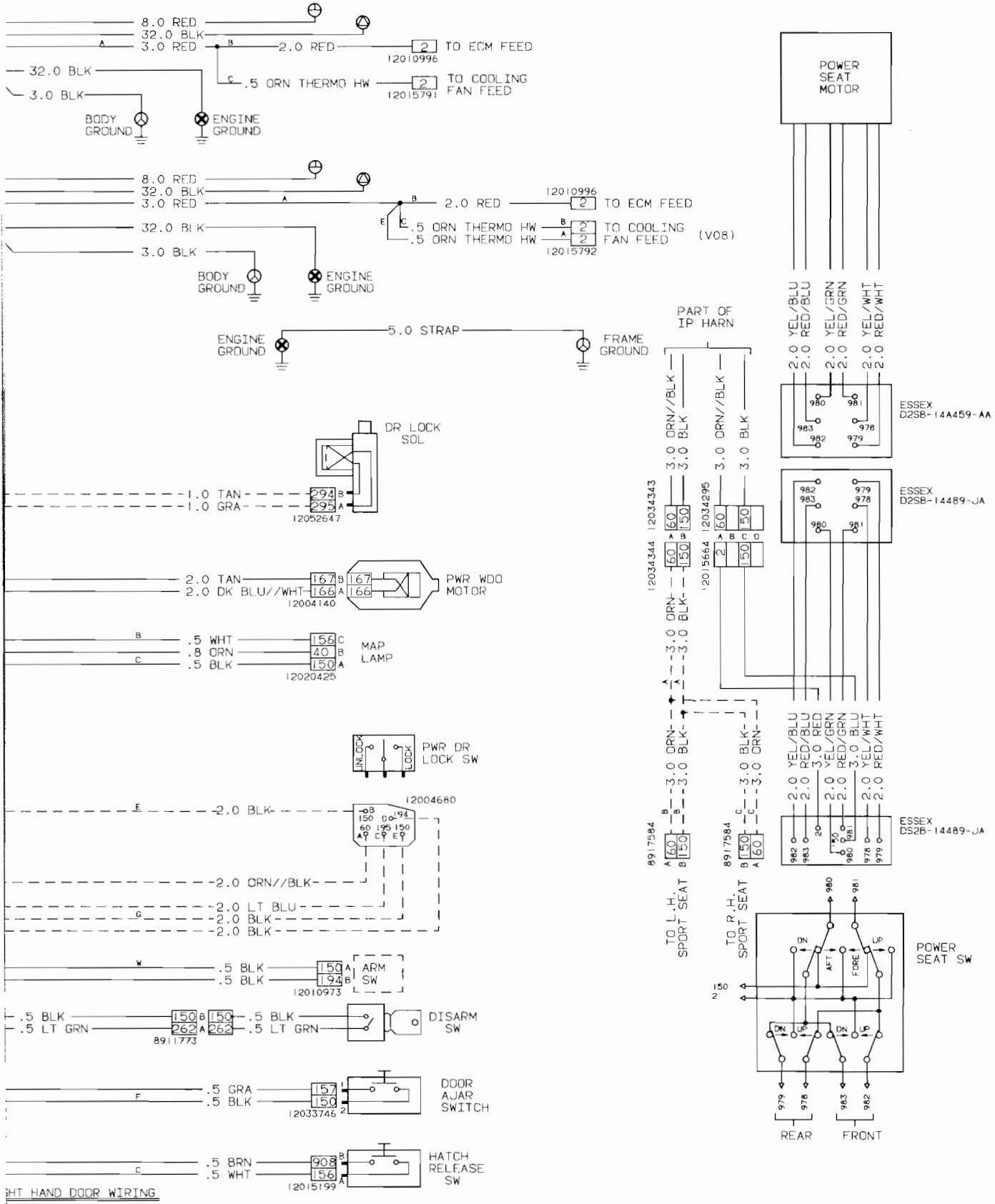

BOSE SYSTEM RH REAR
BOSE SYSTEM LH REAR
RT & LT INTERIOR LAMP
8900863
8900863
.8 WHT
.8 BLK//ORN
.8 WHT
.8 BLK//ORN
SIDE MKR LAMP
6294015
.5 BLK
.5 BRN
.8 BLK
1.0 LT GRN
8917822
12015952
12015987
942
3.0 RED//BLK
12015987
12015952
150
3.0 BLK
.5 ORN
.5 LT BLU
.5 PNK
.5 WHT
.8 BRN
12015344
12015345
1.0 ORN
40
1.0 YEL
1.0 DK GRN
1.0 LT GRN
1.0 LT GRN
2.0 TAN//WHT
12034295
3.0 BLK
2.0 TAN//WHT
1.0 DK GRN
12015664
5.0 BLK
3.0 BLK
6.0 STRAP
24
.8 LT BLU
2.0 BLK
.5 BLK
.8 PNK//BLK
2.0 ORN//BLK
.8 WHT
.8 GRA//BLK
.8 DK BLU
12015416
TO EBS JUMPER
BLK
PNK
ORN
12020013
WHT
DK GRN
GRY
12020014
POWER ANTENNA RELAY
POWER ANTENNA
UP MODE GRN+ GRA-
DOWN MODE WHT+ GRN-
ANTENNA GROUND



CONVERTIBLE



CONSOLE WIRING



SHT HAND DOOR WIRING

CORVETTE 1F


CHEVROLET
SERVICE